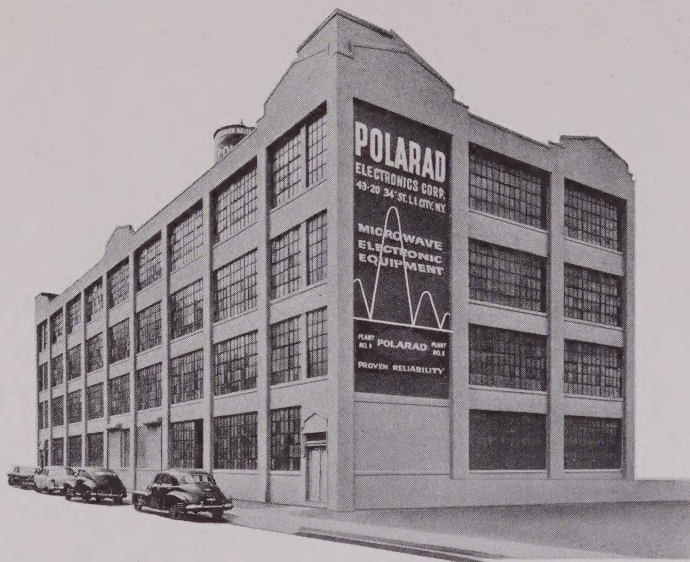




HANDBOOK OF OPERATING INSTRUCTIONS

MICROWAVE
FIELD INTENSITY
METER
MODEL FIM-2

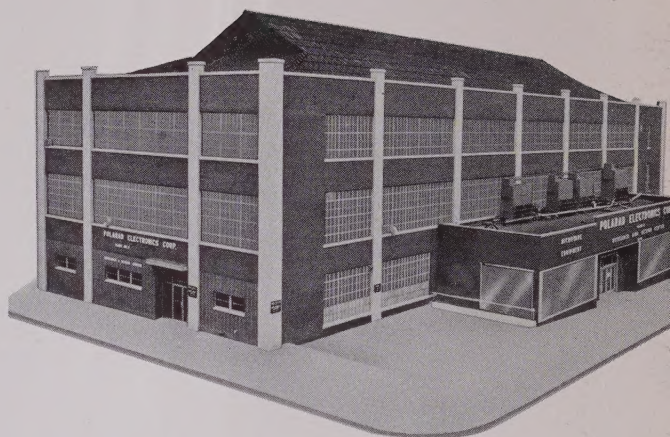
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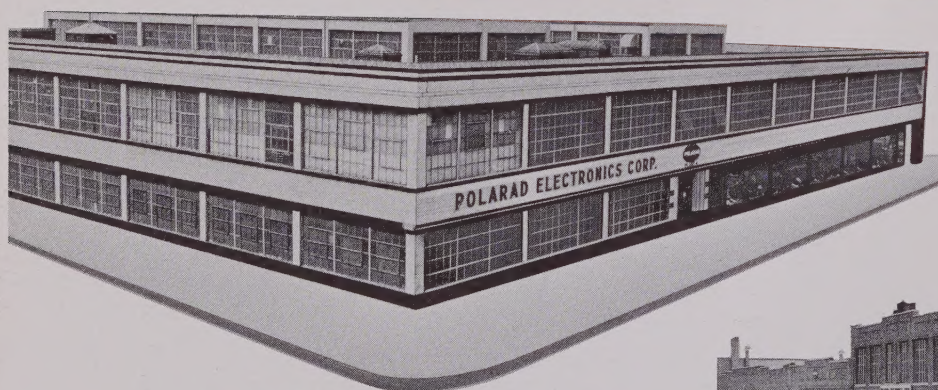
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PLANT 3





INSTRUCTION MANUAL

MICROWAVE FIELD INTENSITY METER MODEL FIM-2

SERIAL NOS. 250 TO 323

POLARAD ELECTRONICS CORPORATION • 43-20 34th St., Long Island City 1, N. Y.

Warranty

Polarad Electronics Corporation warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, fuses or batteries, which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which on our examination shall disclose to our satisfaction to have been thus defective.

Polarad Electronics Corporation reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of the Polarad Electronics Corporation, and Polarad neither assumes nor authorizes any other person to assume for them any other liability in connection with the Sales of Polarad's instruments.



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WARNING:

EXPOSURE TO RADIATION FIELDS GREATER
THAN 10 MILLIWATTS PER SQUARE CENTI-
METER IS DANGEROUS AND CAN BE FATAL
TO HUMAN LIFE.

LEGEND

1. Basic Unit, Model FIM-B2
2. Tuning Unit, Model FIM-X2
3. Calibrated Broadband Omnidirectional Conical Antenna, Model CA-B
4. Calibrated Direction Antenna, Model CA-L
5. Calibrated Direction Antenna, Model CA-S
6. Calibrated Feed Horn, Model CA-M
7. Calibrated Feed Horn, Model CA-X
8. Parabolic Reflector, Model CA-R
9. Antenna Tripod, Model CA-T
10. Electrical Power Cable Assembly W1201
11. Power Cable Adapter CP1201
12. R-f Cable Assembly W1202
13. R-f Cable Assembly W1203
14. I-f Cable Assembly W1204
15. R-f Cable Assembly W1205
16. Patch Cable Assembly W1206
17. D-c Blocking Capacitor C1201
18. Feed Horn Bolt H1201
19. Wrench Kit H1202
20. Allen Wrench H1203
21. Klystron Wrench H1204
22. Klystron Wrench H1205

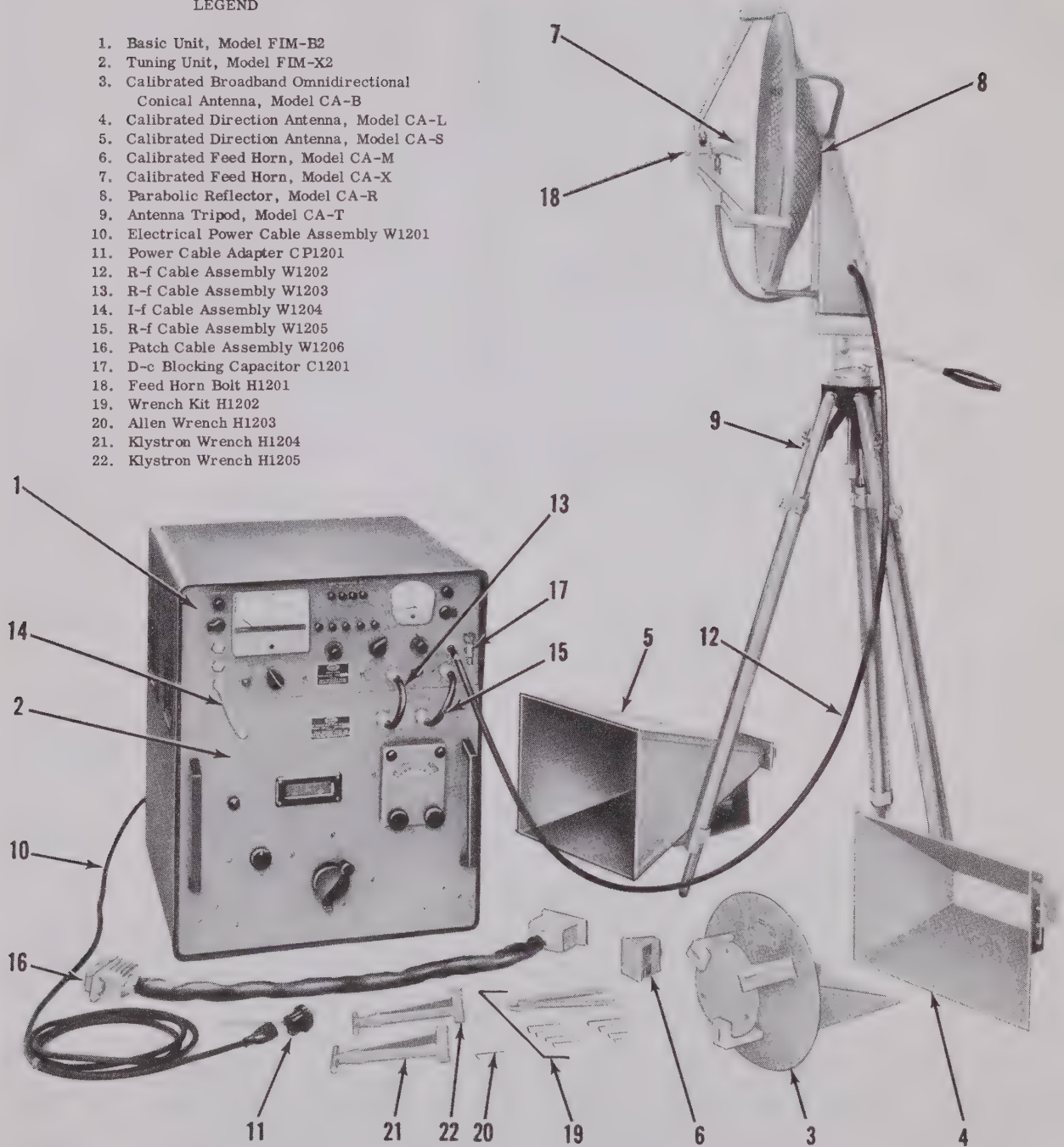


Figure 1-1. Model FIM-2 Field Intensity Meter

SECTION I

INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This manual contains instructions for the use and maintenance of the Model FIM-2 Field Intensity Meter, shown in figure 1-1, which is manufactured by Polarad Electronics Corporation, Long Island City, New York. The manual includes a general description of the equipment, operating instructions, theory of operation, maintenance information, and schematic diagrams.

1-3. PURPOSE AND USE OF THE EQUIPMENT.

1-4. The Model FIM-2 Field Intensity Meter, hereafter referred to as the FIM-2, provides an accurate indication of the frequency and magnitude of an r-f signal lying within the frequency range from 1,000 to 10,000 mc. The amplitude of either narrowband (cw) or broadband (pulsed) r-f signals is read directly from a calibrated output voltmeter having three scales: microvolts, decibels above one microvolt, and decibels above one microvolt per megacycle. In addition to being a sensitive and frequency-selective microwave receiver, the FIM-2 also provides a self-contained calibrated microwave signal generator which covers the same frequency range. Specific uses of the FIM-2 include:

- a. Field intensity measurements.

- b. Measuring the absolute level of r-f interference in accordance with military and commercial specifications.

- c. Determining the susceptibility of other instruments and components to external r-f interference.

- d. Measuring the radiation level of receiver local oscillators
- e. Sensitive r-f voltmeter (power meter)
- f. Antenna pattern analysis
- g. Determining the shielding effectiveness of screen rooms
- h. Determining the harmonic and spurious frequency outputs of transmitters
- i. Propagation studies.
- j. Measuring r-f leakage
- k. Analyzing r-f signals
- l. Analyzing the characteristics of microwave transmitters, receivers, and components.

1-5. GENERAL DESCRIPTION.

1-6. The FIM-2 is a self-contained, compact unit consisting of the Model FIM-B2 Basic Unit and four interchangeable plug-in Tuning Units (Models FIM-L2, FIM-S2, FIM-M2, and FIM-X2). In operation, one of the four plug-in Tuning Units is mounted in the Basic Unit so that the two combine to appear as a single assembly, as shown in figure 1-1.

1-7. The Model FIM-B2 Basic Unit, which contains the control and monitoring circuitry of the FIM-2 system, consists of a panel, chassis, and frame assembly. The front panel assembly occupies the upper front half of the equipment frame and serves as a mounting for the Basic Unit operating controls, indicators, and connectors. The bottom section of the Basic Unit frame has a panel opening which is designed to accept one of the four interchangeable plug-in Tuning Units.

1-8. Each interchangeable plug-in Tuning Unit contains the r-f receiving and signal generating circuitry which is continuously tunable throughout the complete frequency range of the particular Tuning Unit. Its front panel assembly serves as a mounting for the Tuning Unit operating controls, indicators, and connectors.

1-9. FIM-2 SYSTEM COMPONENTS.

1-10. Table 1-1 lists the components comprising the complete FIM-2 system, which is shown in figure 1-1. This list includes the entire complement of Tuning Units and accessories. Note that the Tuning Units and accessories are supplied under the conditions described in paragraphs 1-11 through 1-19.

1-11. MODEL FIM-B2 BASIC UNIT. The Basic Unit, which is the control and monitoring portion of the FIM-2 system, is supplied as an integral component.

1-12. INTERCHANGEABLE PLUG-IN TUNING UNITS. The four Tuning Units available are supplied as ordered. These include:

a. MODEL FIM-L2 TUNING UNIT. This Tuning Unit covers the frequency range from 1,000 to 2,240 mc.

b. MODEL FIM-S2 TUNING UNIT. This Tuning Unit covers the frequency range from 2,140 to 4,340 mc.

c. MODEL FIM-M2 TUNING UNIT. This Tuning Unit covers the frequency range from 4,200 to 7,740 mc.

d. MODEL FIM-X2 TUNING UNIT. This Tuning Unit covers the frequency range from 7,360 to 10,000 mc.

1-13. CALIBRATED ANTENNAS. Four calibrated directional antennas and one calibrated broadband omnidirectional antenna, each having a nominal output impedance of 50 ohms, are available and are supplied

TABLE 1-1. FIM-2 SYSTEM COMPONENTS.

Component	Polarad Model or Part No.	Figure 1-1 Index Number	Overall Dimensions (in.)			Weight (lbs)
			Length	Width	Height	
Basic Unit	FIM-B2	1	25	19	23-1/2	50
Tuning Unit	FIM-L2	Not Shown	12-1/4	18-1/2	15-5/8	50
Tuning Unit	FIM-S2	Not Shown	12-1/4	18-1/2	15-5/8	50
Tuning Unit	FIM-M2	Not Shown	12-1/4	18-1/2	15-5/8	50
Tuning Unit	FIM-X2	2	12-1/4	18-1/2	15-5/8	50
Calibrated Broadband Omnidirectional Conical Antenna	CA-B	3	10-19/32	9-3/16 dia		2.5
Calibrated Directional Antenna	CA-L	4	8	9-7/16	13-3/4	2.0
Calibrated Directional Antenna	CA-S	5	17-11/32	10-1/2	13-29/32	3.5
Calibrated Feed Horn	CA-M	6	2-5/16	2-1/4	2-1/4	0.5
Calibrated Feed Horn	CA-X	7	2-13/32	1-7/16	3-11/32	0.5
Parabolic Reflector	CA-R	8	12-7/8	18	20-13/16	2.0
Antenna Tripod	CA-T	9	5 dia		37-3/8	5.0
Electrical Power Cable Assembly W1201	B111144	10	10 ft	7/16 dia		1.5
Power Cable Adapter GP1201	A131966	11	1	1-1/2 dia		0.3
R-f Cable Assembly W1202	A109817	12	6 ft	1/2 dia		1.5
R-f Cable Assembly W1203	A140572	13	9-3/4	1/2 dia		0.3
I-f Cable Assembly W1204	A140571	14	7-1/4	1/4 dia		0.2
R-f Cable Assembly W1205	A140572	15	9-3/4	1/2 dia		0.3
Patch Cable Assembly W1206	B140565	16	30-1/2	-	-	4.0
D-c Blocking Capacitor CL201	A702098	17	2	1 dia		0.2
Feed Horn Bolt H1201	A100885	18	1-1/2	1 dia		0.1
Wrench Kit H1202	A25109	19	-	-	-	1.0
Allen Wrench H1203	A515305	20	-	-	-	0.1
Klystron Wrench H1204	B144478	21	6-1/4	2 dia		0.5
Klystron Wrench H1205	B144525	22	6-1/4	2 dia		0.5

as ordered. These include:

a. MODEL CA-L CALIBRATED DIRECTIONAL ANTENNA. This antenna is used in conjunction with the Model FIM-L2 Tuning Unit.

b. MODEL CA-S CALIBRATED DIRECTIONAL ANTENNA. This antenna is used in conjunction with the Model FIM-S2 Tuning Unit.

c. MODEL CA-M CALIBRATED FEED HORN. This feed horn is used in conjunction with the Model FIM-M2 Tuning Unit.

d. MODEL CA-X CALIBRATED FEED HORN. This feed horn is used in conjunction with the Model FIM-X2 Tuning Unit.

e. MODEL CA-B CALIBRATED BROADBAND OMNIDIRECTIONAL CONICAL ANTENNA. This broadband antenna may be used in conjunction with any one of the four Tuning Units.

1-14. MODEL CA-R PARABOLIC REFLECTOR. This parabolic reflector, which is supplied only when specifically ordered, is used to focus the input signal at the center of either the Model CA-M or CA-X Calibrated Feed Horn, thereby effectively increasing the areas of these feed horns.

1-15. MODEL CA-T ANTENNA TRIPOD. This antenna tripod, which is supplied only when ordered, is used as a mount for the individual calibrated antennas. Either vertical or horizontal polarization of the antenna may be selected, depending on their orientation. The tripod mounting bracket permits 360-degree rotation in azimuth and 180-degree rotation in elevation. Two locking levers permit locking of the mounted antenna in any position. The tripod legs can be extended from a minimum of $37\frac{3}{8}$ inches to a maximum of 60 inches.

1-16. CABLE ASSEMBLIES. The following cable assemblies are supplied with the equipment:

a. ELECTRICAL POWER CABLE ASSEMBLY W1201 (10 feet long). Input power to the FIM-2 is applied from a 115/230-volt, 50 to 450-cps power outlet via this detachable cable assembly. One termination is a standard three socket connector for mating with the Basic Unit power input receptacle. The other termination is a standard three-prong connector for mating with a polarized power outlet.

b. R-F CABLE ASSEMBLY W1202 (6 feet long). This cable assembly, consisting of type RG-9B/U coaxial cable terminated with type UG-21D/U connectors at each end, is employed to couple the r-f signal under measurement from the calibrated antenna output connector to the Basic Unit RF IN jack.

c. R-F CABLE ASSEMBLIES W1203 AND W1205 (9-3/4 inches long). These cable assemblies, each consisting of type RG-9B/U coaxial cable terminated with type UG-21D/U connectors at each end, are employed as front panel jumpers: W1203 to couple the Basic Unit ATTEN OUT jack to the Tuning Unit PRESEL IN jack; W1205 to couple the Tuning Unit SIG GEN OUT jack to the Basic Unit CAL IN jack.

d. I-F CABLE ASSEMBLY W1204 (7-1/4 inches long). This cable assembly, consisting of type RG-55/U coaxial cable terminated with type UG-88/U connectors at each end, is employed as a front panel jumper to couple the Tuning Unit MIXER OUT jack to the Basic Unit IF IN jack.

e. PATCH CABLE ASSEMBLY W1206 (30-1/2 inches long). This harnessed cable assembly, terminated at each end with multipin connectors, is employed to interconnect the Tuning Unit and Basic Unit when performing routine maintenance operations.

1-17. HARDWARE. The hardware listed below is either supplied with the equipment or available as an accessory, as indicated:

a. FEED HORN BOLT H1201. This bolt is supplied with the Model CA-R Parabolic Reflector (an accessory supplied only when specifically ordered) for mounting the Model CA-M or Model CA-X Calibrated Feed Horn to the reflector.

b. WRENCH KIT H1020. This kit is supplied with the equipment and contains the hand tools required to adjust and align the FIM-2. The contents of this kit are listed below in table 1-2.

TABLE 1-2. WRENCH KIT TOOLS.

Tool	Polarad Part No.
Spanner Wrench H1206	AP15550
No. 4 Spline Wrench H1207	A515101
No. 6 Spline Wrench H1208	A515102
No. 8 Spline Wrench H1209	A515103
No. 10 Spline Wrench H1210	A515104
No. 4 Allen Wrench H1211	A515301
No. 6 Allen Wrench H1212	A515302
No. 8 Allen Wrench H1213	A515303
No. 10 Allen Wrench H1214	A515304

c. ALLEN WRENCH H1203. This 1/8-inch allen wrench is supplied with the Model CA-T Antenna Tripod (an accessory supplied only when specifically ordered), and is used to adjust the position of the tripod mounting screw.

d. KLYSTRON WRENCHES H1204 AND H1205. These klystron wrenches are supplied with the Tuning Unit ordered. Klystron wrench H1204 is employed to position the reflex klystrons used in the Model FIM-L2 and Model FIM-S2 Tuning Units; klystron wrench H1205 is used

to position the reflex klystrons employed in the Model FIM-M2 and Model FIM-X2 Tuning Units.

1-18. D-C BLOCKING CAPACITOR Cl201. This capacitor is supplied chained to the CAL IN jack and is used in conjunction with the SIG GEN OUT jack when the FIM-2 is employed as a calibrated microwave signal generator for susceptibility to conducted interference tests in conjunction with a line stabilization network.

1-19. POWER CABLE ADAPTER CPl201. This adapter is supplied with the equipment and is used to adapt a two-wire power outlet to the polarized three-prong connector terminating electrical power cable assembly 1201.

1-20. TECHNICAL CHARACTERISTICS.

1-21. The technical characteristics of the FIM-2 are listed below.

Frequency range (field intensity meter and calibrated microwave signal generator).....	1,000 to 10,000 mc in four overlapping bands
Model FIM-L2 Tuning Unit.....	1,000 to 2,240 mc
Model FIM-S2 Tuning Unit.....	2,140 to 4,340 mc
Model FIM-M2 Tuning Unit.....	4,200 to 7,740 mc
Model FIM-X2 Tuning Unit.....	7,360 to 10,000 mc
Frequency dial calibration accuracy..	$\pm 1\%$
Receiver type.....	Triple-conversion superheterodyne
Minimum r-f sensitivity.....	20 microvolts (-81 dbm)
Maximum r-f input signal.....	3 volts rms (+22.5 dbm)
Input impedance.....	50 ohms nominal
Impulse bandwidth.....	5 mc
Image and spurious response rejection.....	60 db
Signal attenuation.....	0 to 80 db in 1-db steps
R-f.....	0 to 60 db in 20-db steps
I-f.....	0 to 20 db in 1-db steps

Intermediate frequencies	Three
First	260 mc
Second	140 mc
Third	40 mc
Calibration signal	0.223 volts rms to 5 microvolts (0 to -95 dbm) ± 1 db with correction chart
External Modulation	Square wave; 50 volts minimum (peak-to-peak)
	Positive pulse; +50 to +100 volts peak; 1 to 10,000 pps; 1 μ s wide to 50% duty cycle (Basic Unit serial nos. 291, 294, 297, 298, 307 to 312, 315, 316, 321, and 322)
Measurements	Average, quasi-peak, slideback-peak, and direct peak
Weighting circuit time constants:	
Average and slideback-peak	0.1 usec charge time; 0.3 usec discharge time
Quasi-peak	50 usec charge time; 500 millisecc discharge time
Peak	0.1 usec charge time; 2.0 usec discharge time
Audio output	100 milliwatts into 600 ohms
Video output	0.5 volts (minimum) into 2 megohms
Recorder output	0 to 0.1 volt into 100K
Power requirements	115 or 230 volts ($\pm 10\%$); 50 to 450 cps siggle-phase; 700 watts

1-22. ELECTRON TUBE, CRYSTAL DIODE, SEMICONDUCTOR, FUSE, AND INDICATOR LAMP COMPLEMENT.

1-23. Table 1-3 lists the types and quantities of the entire complement of electron tubes, crystal diodes, and semiconductors employed in the FIM-2 system. The types and quantities of the fuses and indicator lamps are listed in table 1-4.

TABLE 1-3. ELECTRON TUBE, CRYSTAL DIODE, AND SEMICONDUCTOR COMPLEMENT

ASSEMBLY	ELECTRON TUBE, CRYSTAL DIODE, AND SEMICONDUCTOR TYPE																														TOTALS								
	B600 SV5	OA2	OB2	1N23D	1N54	1N69	1N82A	1N91	1N198	1N459	1N1218	1N1341	1N2361	1N2510	2E4	2N207	2N277	2N456	6AH6	6AK5	6AL5	6AN5	6AQ5	6AR6	6AS7	6AU6	6U8	12AT7	12AX7	50M140ZR5		61 - 1501	807	5687	5876	7049/ZV1009	7505/ZV1010	8052/ZV1011	
Model FIM-L2 Tuning Unit				1																											2					2 ¹		5	
Model FIM-S2 Tuning Unit				1																											2				2 ¹		5		
Model FIM-M2 Tuning Unit				1																											2					2 ¹		5	
Model FIM-X2 Tuning Unit														1																	2					2 ¹		5	
260/140 - Mc Preamplifier							1																											2				3	
140/40 - Mc I-f Amplifier																				7	1	1											1				10		
Crystal - Controlled Local Oscillator																				3						1												4	
Afc-I-f Amplifier						2														2						4												8	
Audio-Metering Chassis																						1				1	1	1	1									5	
Low-Voltage Power Supply and Front Panel Circuitry	4	1		1	1			1	1	1	4	2			4	1	2	1							2	1					1							28	
High-Voltage Power Supply			3	1									8						1					1						2			2					18	
Model FIM-B2 Basic Unit	4	1	3	2	1	2	1	1	1	1	4	2	8		4	1	2	1	1	12	1	1	1	1	2	6	1	2	3	1		2	1	2				76 ²	
TOTALS	4	1	3	2	3	1	2	1	1	1	1	4	2	8	1	4	1	2	1	1	12	1	1	1	1	2	6	1	2	3	1	8	2	1	2	2	2	4	96 ³

- Notes: 1. See table 3-1.
2. Total in Model FIM-B2 Basic Unit.
3. Total in complete FIM-2 system.

TABLE 1-4. FUSE AND INDICATOR LAMP COMPLEMENT.

Type	Quantity
FUSES	
3AG, 1/16 amp, 250 volts, SLO BLO	1
3AG, 150 ma, 125 volts, SLO BLO	1
3AG, 6 amps, 250 volts	2
3AG, 2 amps, 250 volts	1
3AG, 8 amps, 32 volts, SLO BLO	1
INDICATOR LAMPS	
47	8
328	8
NE51	2

SECTION II

OPERATION

2-1. PRELIMINARY INSPECTION.

2-2. The FIM-2 is shipped complete and ready to use upon delivery. After unpacking the system, inspect the equipment for possible damage that might have been incurred during shipment as outlined in the following steps.

a. Inspect the front panel handles, captive-lock fasteners, and connectors for security of mounting.

b. Inspect the exterior of the equipment to ascertain that it is free from dents, gouges, and scratches.

c. Inspect the front panel controls for rotation without binding, proper indexing with panel markings, ease of operation, and tightness on their shafts.

WARNING

THE FIM-2 (WITH A PLUG-IN TUNING UNIT INSTALLED) WEIGHS APPROXIMATELY 200 POUNDS. TWO PEOPLE SHOULD BE EMPLOYED AT ALL TIMES WHEN UNPACKING, LIFTING, TRANSPORTING, OR REPACKING THE EQUIPMENT.

d. Grasp the FIM-2 by its four recessed handles and place it on a work bench with the rear of the equipment facing the operator.

e. Turn each of the four captive-lock fasteners (one located at each corner at the rear of the dust cover) one-quarter turn counterclockwise with the aid of a screwdriver.

f. Carefully turn the FIM-2 around so that the front panel faces the operator.

g. With two men working on the FIM-2 (one on each side of the equipment), grasp the two Tuning Unit front panel handles. Carefully slide the FIM-2 forward and out of its dust cover.

h. With the component parts mounted on the Basic Unit and Tuning Unit now visible and accessible, inspect the FIM-2 to make certain that all electron tubes are firmly seated in their sockets with their shields or clamps properly in place.

i. Examine the inter-assembly cabling (see figure 5-8) to ascertain that all cable connectors are securely attached to their mating receptacles.

j. Replace the FIM-2 into its dust cover and secure it by turning the four captive-lock fasteners one-quarter turn clockwise.

2-3. EQUIPMENT INSTALLATION.

2-4. After inspecting the FIM-2, plan its location. The FIM-2 is furnished in a cabinet mounted configuration, as shown in figure 2-1. Figures 2-2 through 2-8 are installation outline drawings of a typical Tuning Unit and the available optional accessories.

2-5. OPERATING CONTROLS, INDICATORS, AND CONNECTORS.

2-6. The operating controls, indicators, and connectors necessary for the operation of the FIM-2 are located on the Basic Unit and Tuning Unit front panel assemblies, as shown in figure 2-9. Their functions are described in table 2-1.

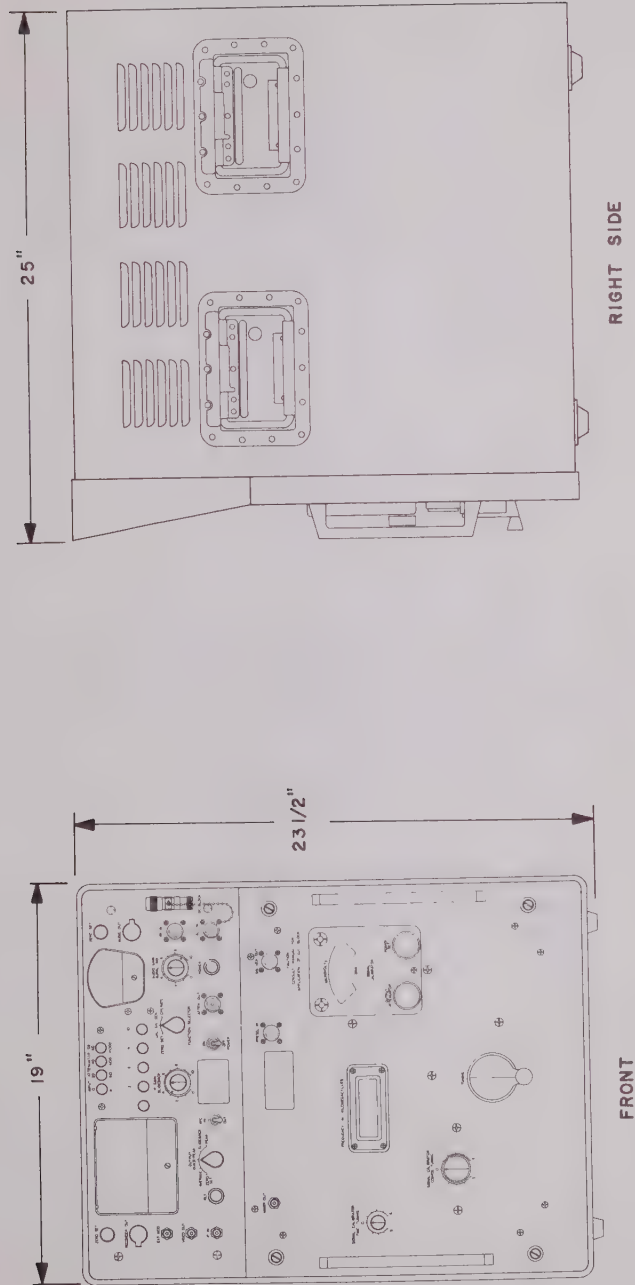


Figure 2-1. Model FIM-B2 Basic Unit with Typical Tuning Unit
Installed, Installation Outline Drawing

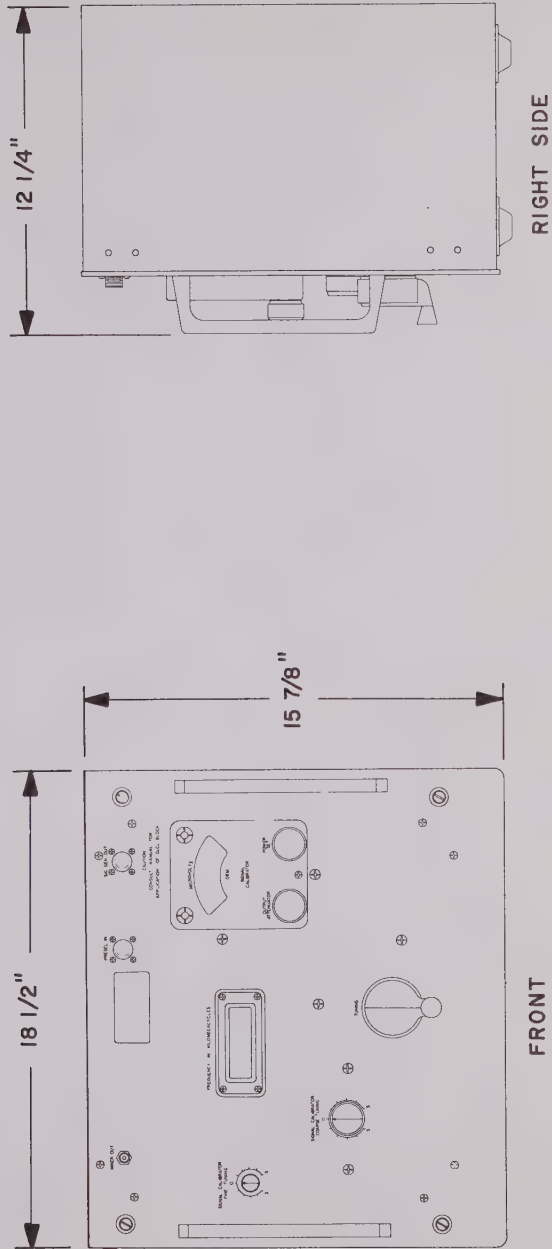


Figure 2-2. Typical Tuning Unit in Storage Container, Installation Outline Drawing

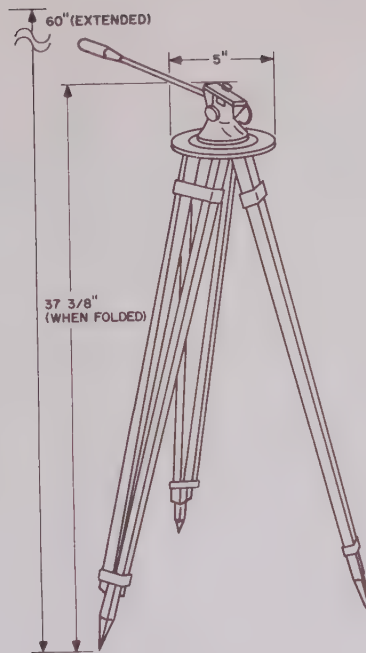


Figure 2-3a. Model CA-T Antenna Tripod, Installation Outline Drawing

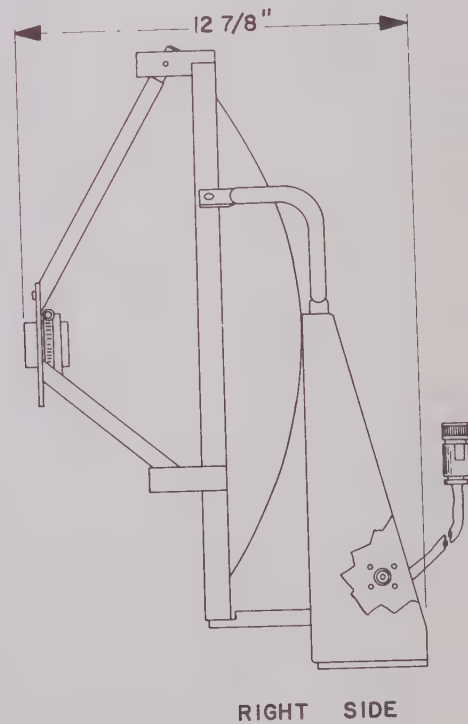
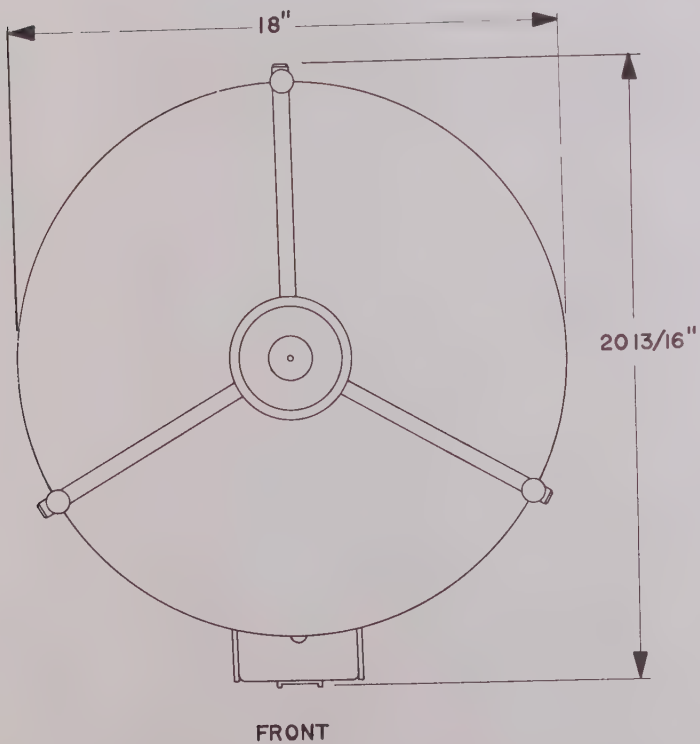


Figure 2-3b. Model CA-R Parabolic Reflector, Installation Outline Drawing

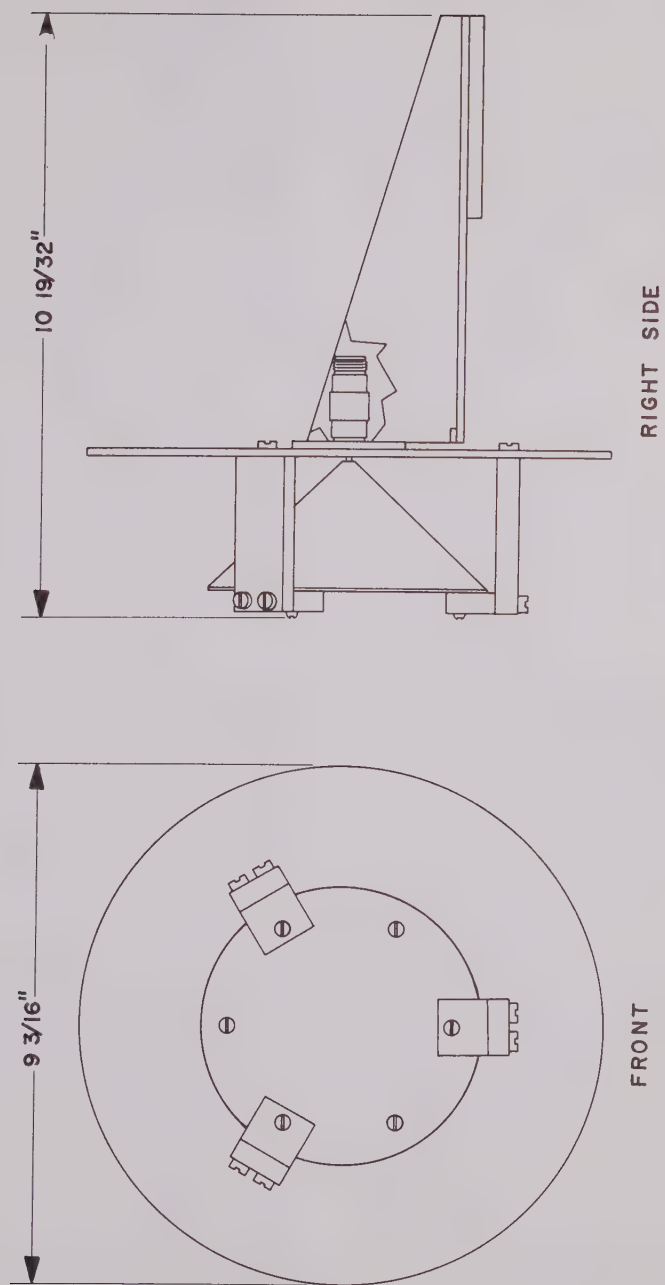


Figure 2-4. Model CA-B Calibrated Broadband Omnidirectional Conical Antenna,
Installation Outline Drawing

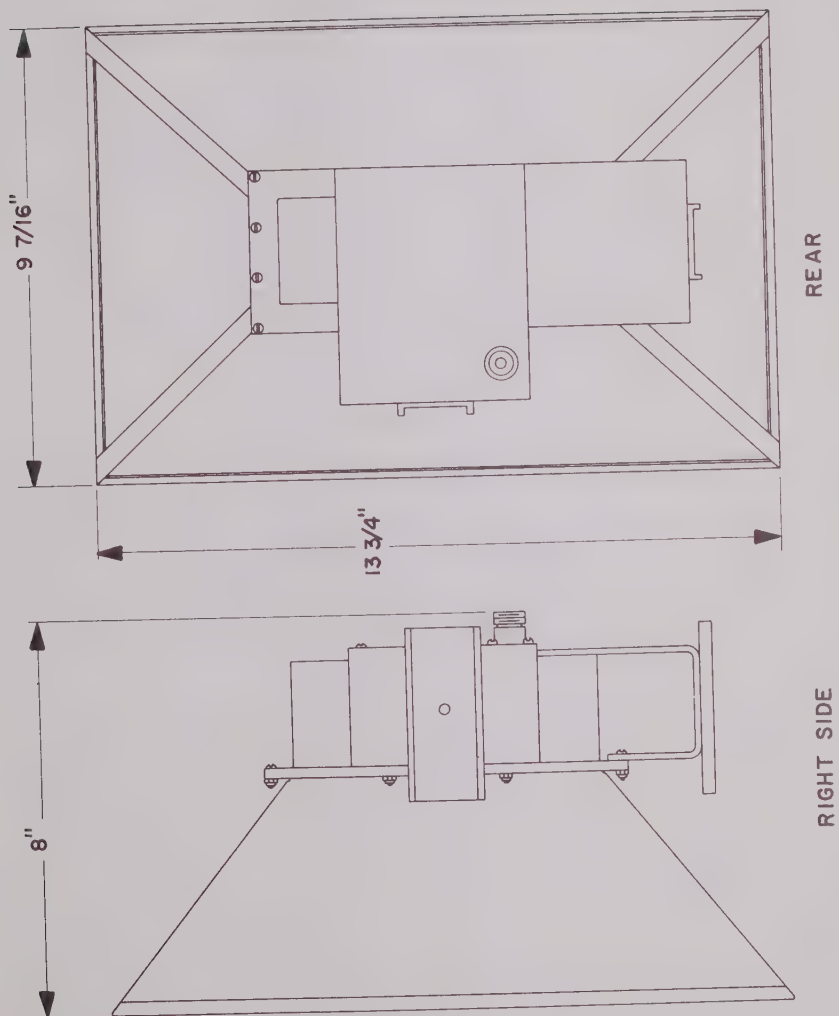


Figure 2-5. Model CA-L Calibrated Directional Antenna, Installation Outline Drawing

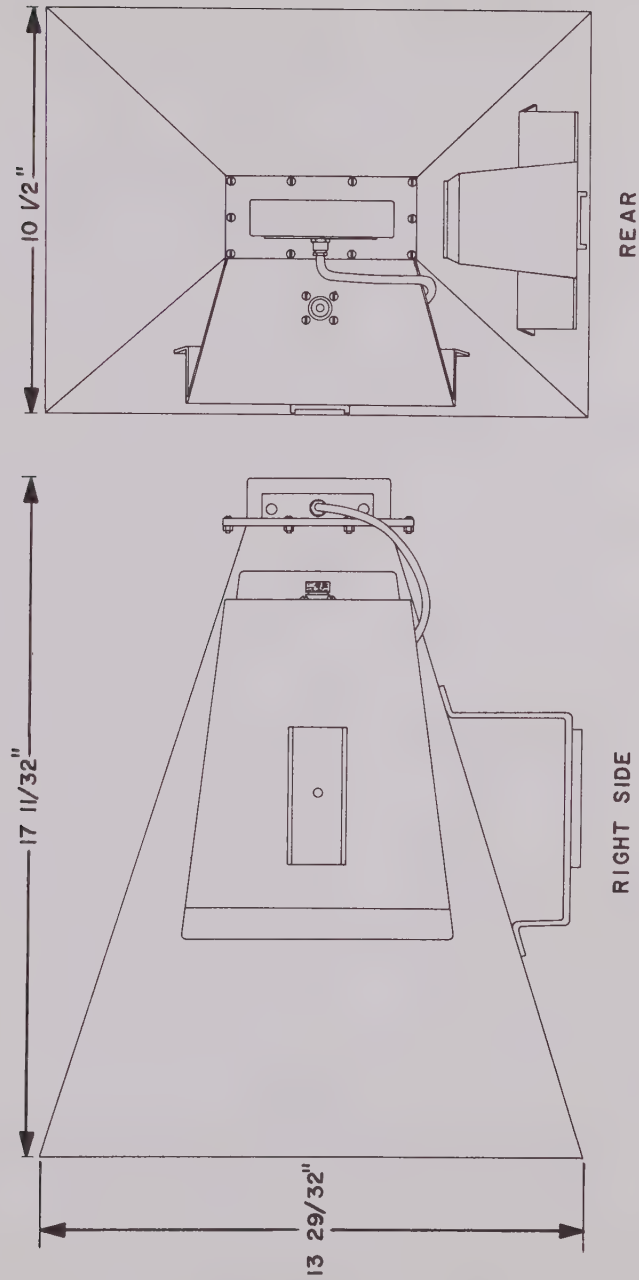


Figure 2-6. Model CA-S Calibrated Directional Antenna, Installation Outline Drawing

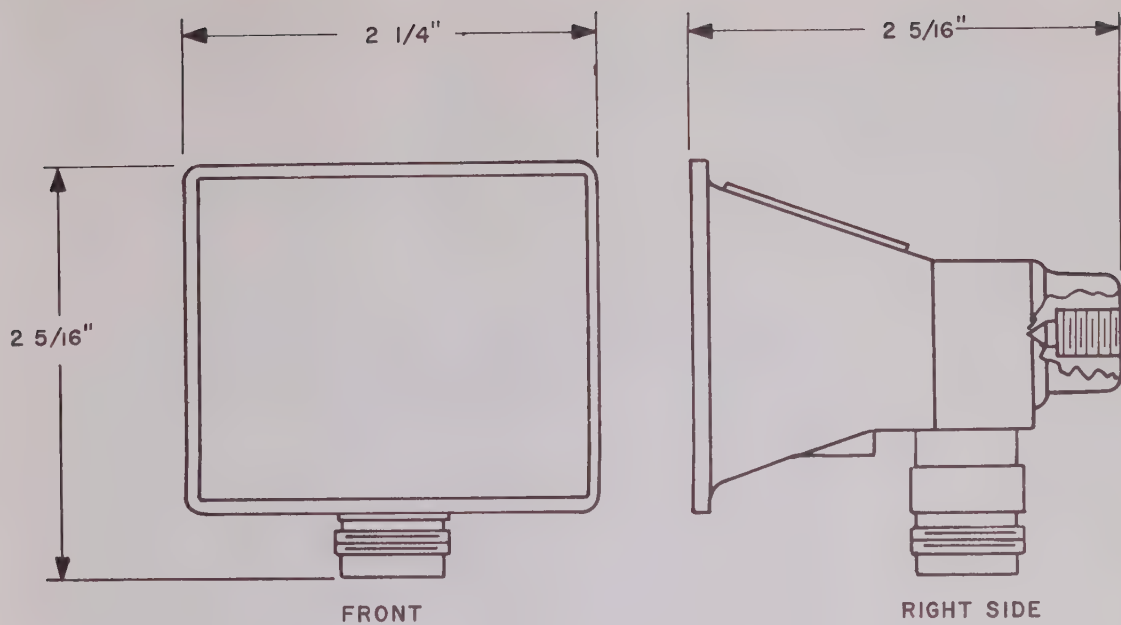


Figure 2-7. Model CA-M Calibrated Feed Horn,
Installation Outline Drawing

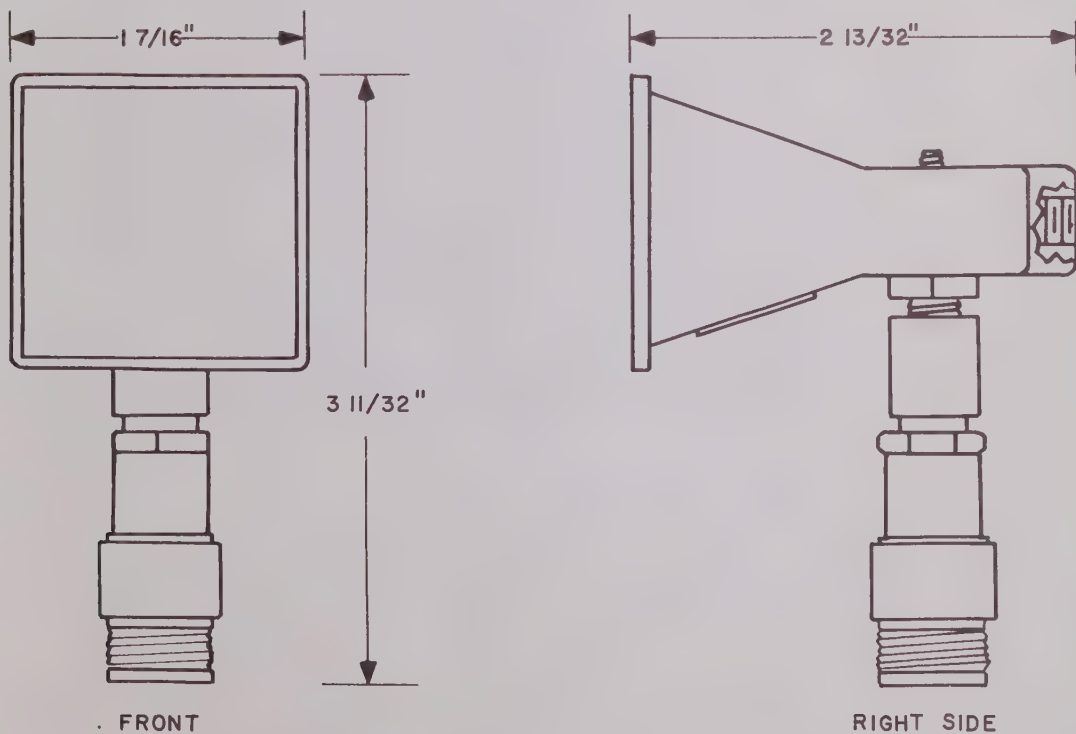


Figure 2-8. Model CA-X Calibrated Feed Horn,
Installation Outline Drawing

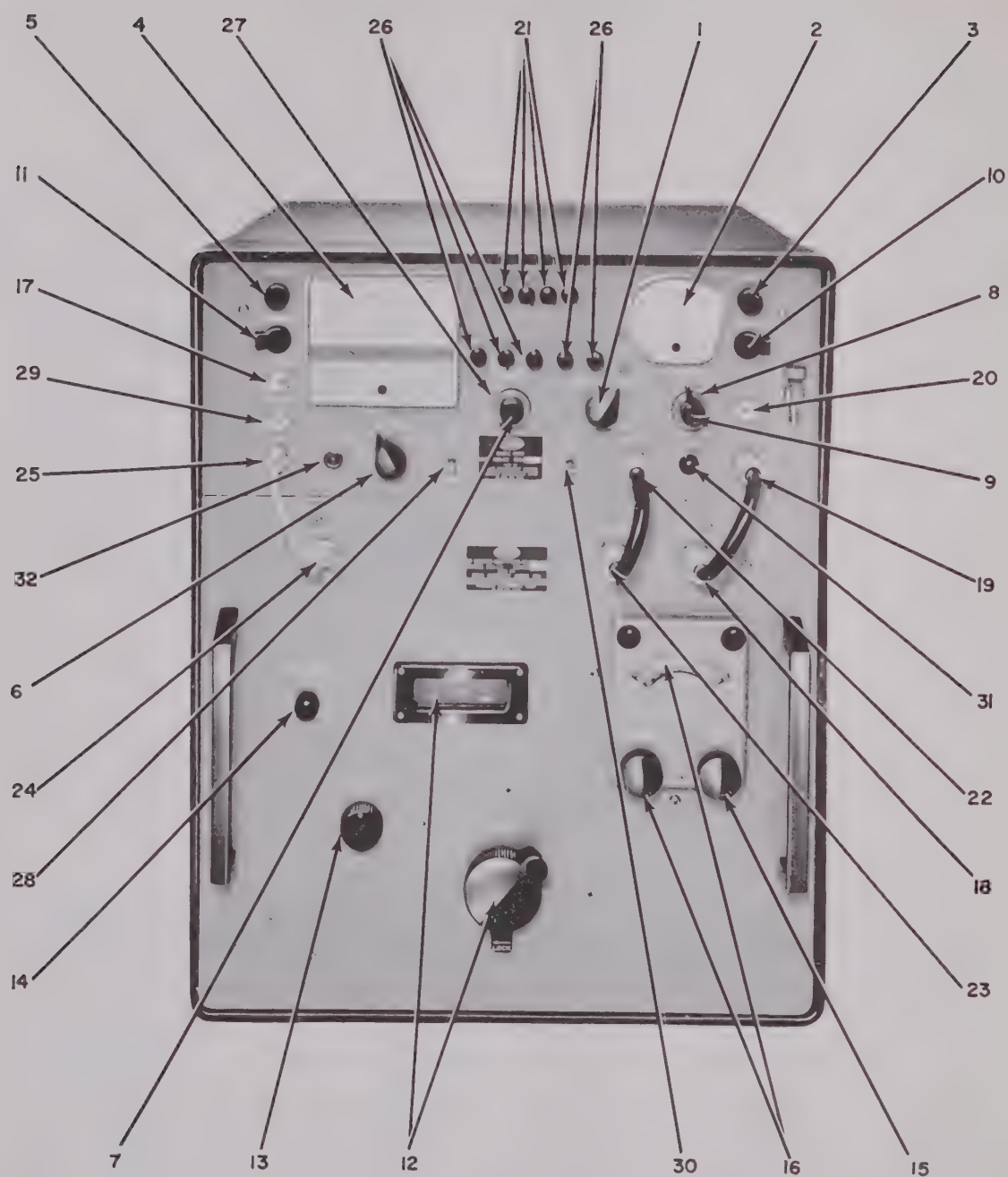


Figure 2-9. Operating Controls, Indicators, and Connectors

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

Front Panel Designation	Figure 2-9 Index No.	Function
FUNCTION SEL switch	1	Selects operating function of the system, as follows: a. ZERO SET - permits zero-setting of power monitor meter b. CAL SIG GEN - FIM-2 operates as a calibrator for the microwave receiver or as a standard signal generator c. OPERATE - FIM-2 operates as a sensitive microwave receiver
Power monitor meter	2	Monitors the signal calibrator power level and the operating voltages and currents generated within the FIM-2, as determined by the setting of the Test Selector switch.
Power monitor meter ZERO SET control	3	Zero-sets the power monitor meter.
Output meter	4	Indicates the average, quasi-peak, slideback-peak, or peak value of applied r-f signal.
Output meter ZERO SET control	5	Zero-sets the output meter.
OUTPUT switch	6	Selects measurement to be made, as follows: a. ZERO SET - permits zero-setting of output meter b. AVERAGE - average value of r-f signal is evaluated c. QUASI-PEAK - interference capability (nuisance value) of r-f signal is evaluated d. SLIDEBACK - peak value of

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (cont'd).

Front Panel Designation	Figure 2-9 Index No.	Function
OUTPUT switch (cont'd)		r-f signal evaluated by slideback technique in conjunction with SLIDEBACK control and AUDIO GAIN control e. PEAK - peak value of r-f signal evaluated by direct reading peak voltmeter
SLIDEBACK control	7	Permits evaluation of peak value of r-f signals by slideback technique in conjunction with AUDIO GAIN control.
AUDIO GAIN control	8	Used in conjunction with SLIDEBACK control when evaluating peak value of r-f signal by slideback technique and when monitoring audio-modulated signals.
AURAL AID control and switch	9	Facilitates detection of r-f signal by 1,000-cps modulation of i-f signal.
AUDIO OUT jack	10	Provided for aural monitoring of modulation through external 600-ohm headset.
RECORDER OUT jack	11	Provided for simultaneous recording of output meter indication on external 100-kilohm recorder.
TUNING control and FREQUENCY IN KILO-MEGACYCLES dial	12	Tunes the receiver and signal calibrator to the frequency indicated on the dial (with an accuracy of $\pm 1\%$).
SIGNAL CALIBRATOR COARSE TUNING control	13	Mechanically trims physical length of signal calibrator external resonant cavity.

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (cont'd)

Front Panel Designation	Figure 2-9 Index No.	Function
SIGNAL CALIBRATOR FINE TUNING control	14	Electrically centers operating mode of signal calibrator reflex klystron.
SIGNAL CALIBRATOR POWER SET control	15	Sets output level of signal calibrator at 0 dbm (± 1 db with the use of the correction curves supplied with the Tuning Unit in use).
SIGNAL CALIBRATOR OUTPUT ATTENUATOR control and -DBM MICROVOLTS dial	16	Varies r-f output of signal calibrator from 0 to -95 dbm (0.223 volts rms to 5 microvolts) with an accuracy of ± 1 db, as indicated on the dial.
EXT MOD jack	17	Provided for external 1,000-cps square-wave modulation of signal calibrator.
SIG GEN OUT jack	18	Front panel connector at which output of signal calibrator is available.
CAL IN jack	19	Front panel connector which couples output of signal calibrator to receiver r-f input attenuators.
RF IN jack	20	Front panel connector which couples output of calibrated antenna to receiver r-f input attenuators
R-f INPUT ATTENUATOR DB push-button switches	21	Inserts r-f attenuation in 20-db steps from 0 to 60 db.
ATTEN OUT jack	22	Front panel connector at which output of r-f attenuators is available.

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS (cont'd).

Front Panel Designation	Figure 2-9 Index No.	Function
PRESEL IN jack	23	Front panel connector which couples r-f signal under measurement to preselector.
MIXER OUT jack	24	Front panel connector at which the first i-f signal is available.
IF IN jack	25	Front panel connector which couples first i-f signal to pre-amplifier.
I-f Input Attenuator Db push-button switches	26	Inserts i-f attenuation in 1-db steps from 0 to 20 db.
IF GAIN control	27	Adjusts overall gain of receiver and is used when calibrating the system.
AFC switch	28	Compensates for incoming signal frequency drift when in the IN position.
VIDEO OUT jack	29	Front panel connector for use with an external oscilloscope when monitoring modulation components.
POWER switch	30	Energizes the FIM-2.
POWER pilot lamp	31	Indicates FIM-2 is energized.
KLY pilot lamp	32	Indicates high-voltage power supply is energized.

2-7. OPERATING CHECKS.

2-8. The operating checks outlined below serve a dual purpose; they serve to determine if the newly arrived system operates properly, and to familiarize the operator with the functions of the operating controls, indicators, and connectors. If any step listed below cannot be successfully completed, the FIM-2 is not functioning properly and reference should be made to the maintenance and/or alignment procedures contained in section IV.

a. Remove the Model FIM-S2 Tuning Unit from its storage container and insert the Tuning Unit into the Basic Unit. (If the FIM-S2 has not been procured, use that Tuning Unit available. The operating checks, however, should be modified to incorporate signal frequencies that are compatible with the Tuning Unit used.)

CAUTION:

DO NOT INSERT A TUNING UNIT INTO (OR REMOVE A TUNING UNIT FROM) THE BASIC UNIT WHEN THE FREQUENCY IN KILO-MEGACYCLES DIAL INDICATES A FREQUENCY OTHER THAN THE HIGH END OF THE BAND.

b. Set the POWER switch to the OFF position.

CAUTION:

THE BASIC UNIT IS FACTORY SET FOR OPERATION FROM A 115-VOLT LINE. IF THE SYSTEM IS TO BE OPERATED FROM A 230-VOLT LINE, BE SURE TO SET THE 115/230V SWITCH, LOCATED AT THE REAR OF THE BASIC UNIT, TO THE 230V POSITION.

c. Connect a nominal 115-volt, 50 to 450-cps single-phase source of power to Power Input receptacle J100, located at the bottom rear of the Basic Unit, via electrical power cable assembly W1201 (and power cable adapter CPl201, if necessary).

d. Set the POWER switch to the ON position. The POWER pilot lamp will immediately light, indicating that line power is being applied to the FIM-2. After a 60-second delay the KLY pilot lamp will light, indicating that the high-voltage power supply is energized. Allow the FIM-2 to warm up for at least 15 minutes.

e. Connect r-f cable assembly W1205 as a jumper between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-10.

f. Connect r-f cable assembly W1203 as a jumper between the ATTEN OUT jack and the PRESEL IN jack, as shown in figure 2-10.

g. Connect i-f cable assembly W1204 as a jumper between the MIXER OUT jack and the IF IN jack, as shown in figure 2-10.

h. Depress the r-f INPUT ATTENUATOR DB push-button switch marked OX1.

i. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system (all buttons out).

j. Set the FUNCTION SEL switch to the ZERO SET position.

k. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer indication of ZERO.

l. Set the OUTPUT switch to the ZERO SET position.

m. Adjust the output meter ZERO SET control to zero-set the output meter pointer.

n. Set the AFC switch to the OUT position.

o. Set the FUNCTION SEL switch to the OPERATE position.

p. Set the OUTPUT switch to the AVERAGE position.

q. Adjust the IF GAIN control so that the noise present in the system produces an output meter pointer deflection of 20 on the RF UV scale.

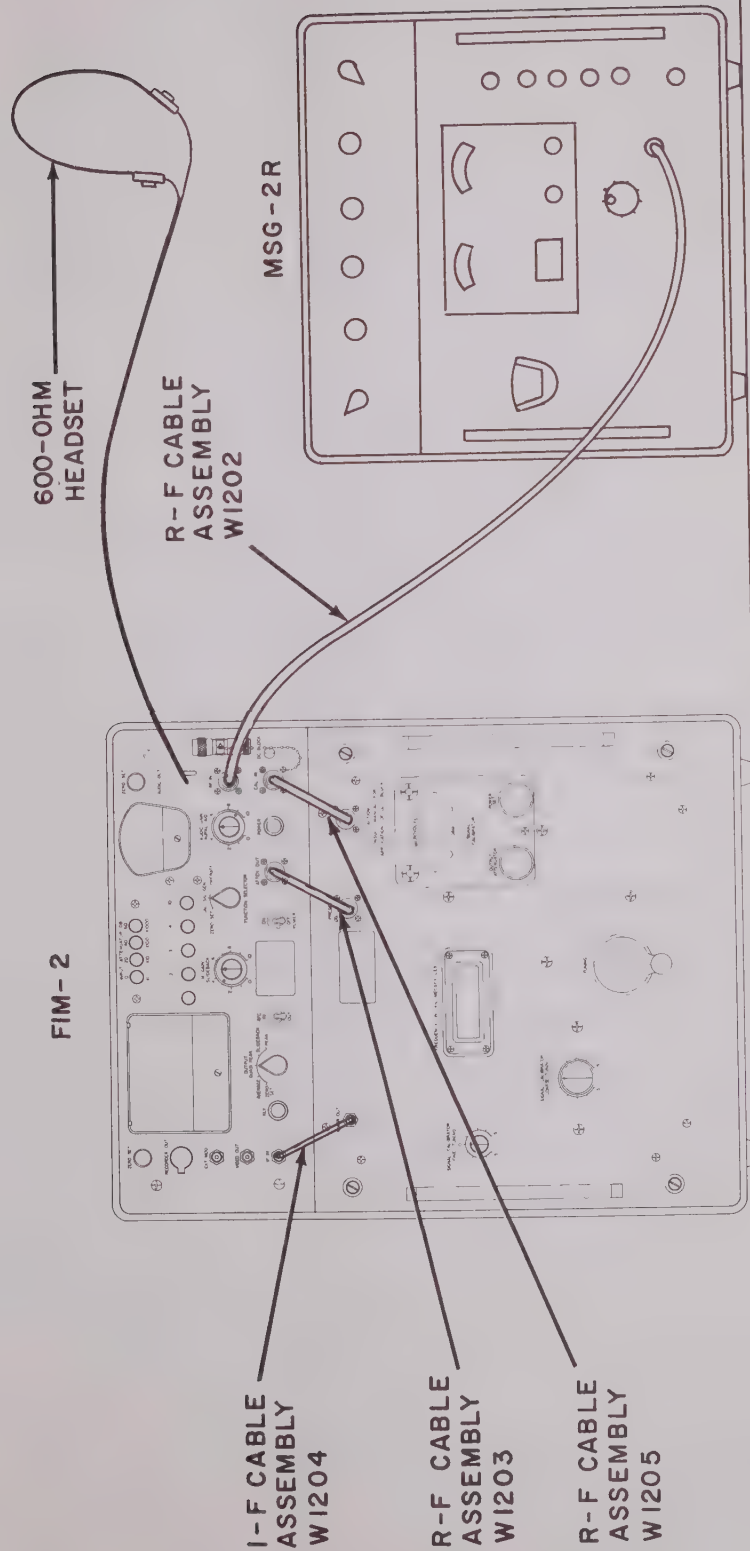


Figure 2-10. Operating Checks, Equipment Set Up

r. Connect r-f cable assembly W1202 between the RF IN jack and the output connector of a calibrated microwave signal generator (such as the Polarad Model MSG-2A or MSG-2R Microwave Signal Generator), as shown in figure 2-10.

s. Adjust the calibrated microwave signal generator for a cw output of 800 microvolts at any frequency within the tuning range of the Model FIM-S2 Tuning Unit.

t. Connect a 600-ohm headset to the AUDIO OUT jack, as shown in figure 2-10.

u. Rotate the AURAL AID control clockwise, beyond its "off" position, to a front panel indication of 5.

v. Rotate the AUDIO GAIN control clockwise to a front panel indication of 5.

w. Rotate the TUNING control throughout the band in search of the r-f signal. When the output meter pointer deflects to an indication of greater than 20 (on the RF UV scale), or when a 1,000-cps aural indication is heard in the headset, the Tuning Unit is tuned to the frequency of the calibrated microwave signal generator. Note the FREQUENCY IN KILOMEGACYCLES dial indication. It should be within $\pm 2\%$ (due to the error imparted by the calibrated microwave signal generator) of that of the MSG-2A or MSG-2R.

x. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.

y. Set the FUNCTION SEL switch to CAL SIG GEN.

z. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to a front panel indication of 0.

aa. Rotate the SIGNAL CALIBRATOR FINE TUNING control to a front panel indication of 0.

ab. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection corresponding to "cal," as indicated on the correction curves supplied with the Model FIM-S2 Tuning Unit.

ac. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of approximately 100 on the RF UV scale.

ad. Adjust the SIGNAL CALIBRATOR COARSE TUNING control to obtain maximum deflection of the output meter pointer.

ae. Adjust the SIGNAL CALIBRATOR FINE TUNING control to peak the deflection of the output meter pointer.

af. Readjust the SIGNAL CALIBRATOR POWER SET control, if necessary, to maintain a power monitor meter pointer deflection corresponding to "cal."

ag. Rotate the IF GAIN control fully counterclockwise.

ah. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a -DBM MICROVOLTS dial indication of 1K on the microvolts scale.

ai. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1,000 on the RF UV scale. This calibrates the receiver for 1,000 microvolts full-scale deflection.

aj. Set the FUNCTION SEL switch to the OPERATE position.

ak. Rotate the AURAL AID control fully counterclockwise, to its "off" position.

al. Note the output meter pointer deflection. This indication, when multiplied by the attenuation factor of 1 (since the OX1 r-f INPUT ATTENUATOR DB push-button switch is depressed), is the value of the cw r-f signal under measurement and should be equal to the signal generator output attenuator dial indication within an accuracy of ± 2 db due to the error imparted by the signal generator (i.e., 800 microvolts ^{+208 microvolts} _{-145 microvolts}).•

am. Set the OUTPUT switch to the QUASI-PEAK position.

an. Note the output meter pointer deflection. It should be the same as that of steps al, above.

ao. Set the OUTPUT switch to the SLIDEBACK position.

ap. Rotate the SLIDEBACK control fully counterclockwise.

aq. Rotate the AURAL AID control clockwise, beyond its "off" position, to obtain a comfortable aural indication from the headset.

ar. Rotate the SLIDEBACK control slowly clockwise, causing the strength of the aural indication to decrease. As the signal approaches inaudibility, rotate both the AURAL AID and AUDIO GAIN controls further clockwise. Continue rotating the SLIDEBACK control clockwise until the aural indication just vanishes.

as. Note the output meter pointer deflection. It should be the same as that of step al, above .

at. Set the OUTPUT switch to the PEAK position.

au. Note the output meter pointer deflection. It should be the same as that of step al, above.

2-9. MEASURING THE AVERAGE VALUE OF R-F SIGNALS.

2-10. The AVERAGE position of the OUTPUT switch is used to evaluate the average value of a narrowband signal (i.e., cw or audio-modulated cw). The output meter will indicate the value of a signal whose peak level is equal to the average value of the narrowband signal under measurement.

2-11. Two methods are available for the measurement of the average value of r-f signals; both apply when the OUTPUT switch is in the AVERAGE position. The first method, the full-scale calibration technique, is described in paragraph 2-12. The second method, the r-f substitution technique, is described in paragraph 2-13.

2-12. FULL-SCALE CALIBRATION TECHNIQUE. To determine the average value of an r-f signal by the full-scale calibration technique, proceed as outlined in the following steps.

a. Apply operating power to the FIM-2 as outlined in paragraph 2-7, steps b through d.

b. Connect r-f cable assembly W1205 as a jumper between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-11.

c. Connect r-f cable assembly W1203 as a jumper between the ATTEN OUT jack and the PRESEL IN jack, as shown in figure 2-11.

d. Connect i-f cable assembly W1204 as a jumper between the MIXER OUT jack and the IF IN jack, as shown in figure 2-11.

e. Depress the r-f INPUT ATTENUATOR DB push-button switch marked 60X1000.

f. Adjust the i-f Input Attenuator Db push-button switches so that there is 20-db of i-f attenuation inserted into the system.

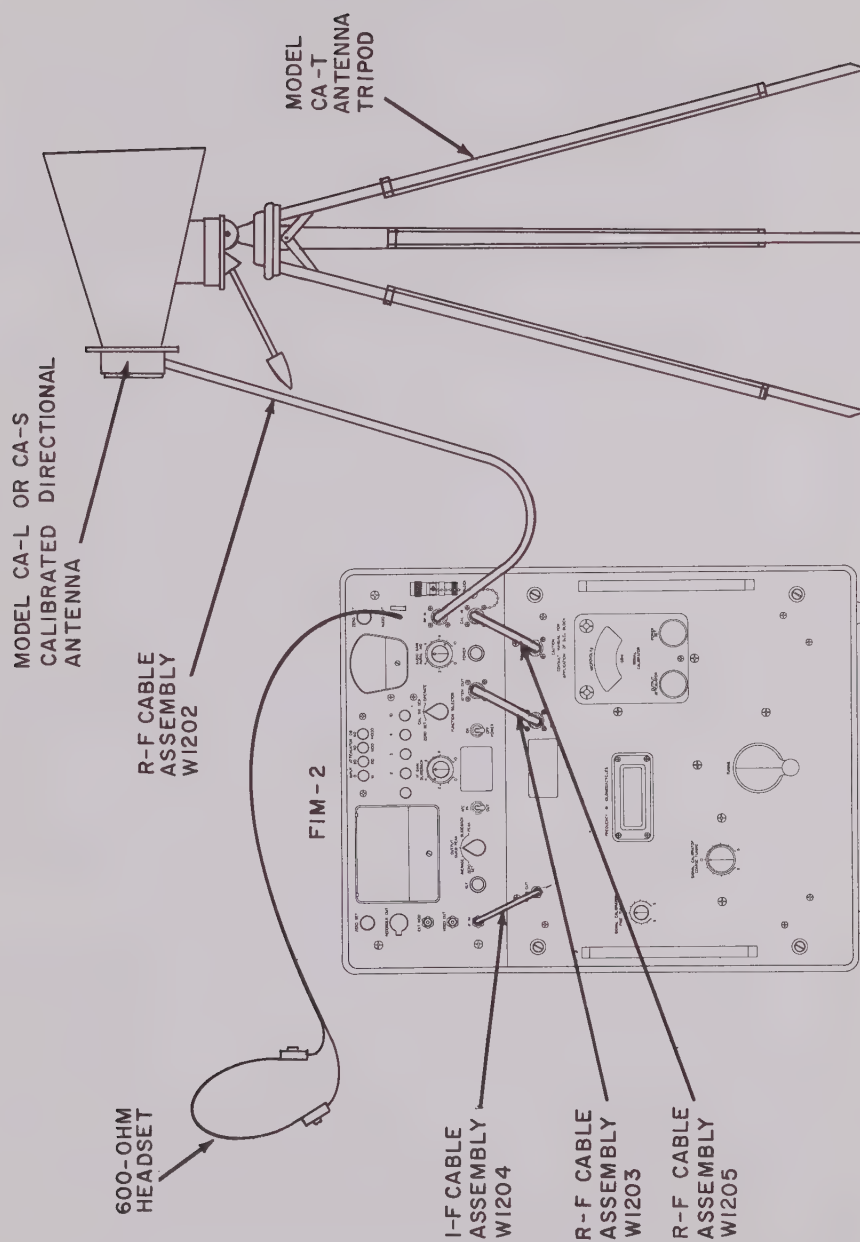


Figure 2-11. Field Intensity Measurements, Equipment Set Up

- g. Set the FUNCTION SEL switch to the ZERO SET position.
- h. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer indication of ZERO.
- i. Set the OUTPUT switch to the ZERO SET position.
- j. Adjust the output meter ZERO SET control to zero-set the output meter pointer.
- k. Set the AFC switch to the OUT position.
- l. Set the FUNCTION SEL switch to the OPERATE position.
- m. Set the OUTPUT switch to the AVERAGE position.
- n. Adjust the IF GAIN control to obtain an output meter pointer deflection of 20 on the RF UV scale.
- o. Connect r-f cable assembly W1202 between the RF IN jack and the output connector of the calibrated antenna corresponding to the Tuning Unit in use, as shown in figure 2-11.

NOTE:

When the Model FIM-M2 or Model FIM-X2 Tuning Unit is being used, connect r-f cable assembly W1202 between the RF IN jack and the bulkhead connector on the Model CA-R Parabolic Reflector. Be sure to connect the additional short length of r-f cable (attached to the other termination of the bulkhead connector) to the output connector of the Model CA-M or Model CA-X Calibrated Feed Horn, respectively.

- p. Connect a 600-ohm headset to the AUDIO OUT jack, as shown in figure 2-11.
- q. Rotate the AURAL AID control clockwise, beyond its "off" position, to an indication of 5.
- r. Rotate the AUDIO GAIN control clockwise to an indication of 5.

s. Rotate the TUNING control throughout the band in search of the r-f signal. When the output meter pointer deflects to an indication greater than 20 on the RF UV scale, or when the 1,000-cps aural indication is heard in the headset, the Tuning Unit is tuned to the frequency of the incoming r-f signal. In the event that neither the output meter nor the headset indicates the presence of an r-f signal, adjust the input attenuation in the sequence listed in table 2-2, below. After each successive adjustment, rotate the TUNING control throughout the band in search of the r-f signal.

TABLE 2-2. SEQUENCE OF INPUT ATTENUATION REMOVAL WHEN SEARCHING FOR INCOMING R-F SIGNAL.

Step	R-f INPUT ATTENUATOR DB Push-button Depressed	R-f Attenuation Inserted	I-f Input Attenuator DB Push-button Depressed	I-f Attenuation Inserted
1	60X1000	60 db	10	10 db
2	40X100	40 db	All	20 db
3	40X100	40 db	10	10 db
4	20X10	20 db	All	20 db
5	20X10	20 db	10	10 db
6	0X1	0 db	All	20 db
7	0X1	0 db	10	10 db
8	0X1	0 db	None	0 db

CAUTION:

THE MAXIMUM R-F INPUT VOLTAGE TO THE FIM-2 IS 3 VOLTS RMS.
 UNDER NO CIRCUMSTANCES, THEREFORE, SHOULD THE OUTPUT METER POINTER DEFLECT TO AN INDICATION GREATER THAN 300 ON THE RF UV SCALE (CORRESPONDING TO 50 ON THE DB ABOVE 1 UV SCALE AND 35 ON THE DB ABOVE 1 UV/MC SCALE) WHEN 60 DB OF R-F ATTENUATION AND 20 DB OF I-F ATTENUATION IS INSERTED INTO THE SYSTEM.

- t. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.
- u. Set the FUNCTION SEL switch to the CAL SIG GEN position.
- v. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to an indication of 0.
- w. Rotate the SIGNAL CALIBRATOR FINE TUNING control to an indication of 0.
- x. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection corresponding to "cal," as indicated on the correction curves supplied with the Tuning Unit in use.
- y. Depress the r-f INPUT ATTENUATOR DB push-button switch marked 0X1.
- z. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.
- aa. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 100 on the RF UV scale.
- ab. Adjust the SIGNAL CALIBRATOR COARSE TUNING control to obtain maximum deflection of the output meter pointer.
- ac. Adjust the SIGNAL CALIBRATOR FINE TUNING control to peak the deflection of the output meter pointer.
- ad. Readjust the SIGNAL CALIBRATOR POWER SET control, if necessary, to maintain a power monitor meter pointer deflection corresponding to "cal."

ae. Rotate the AURAL AID control fully counterclockwise to its "off" position.

af. Rotate the IF GAIN control fully counterclockwise.

ag. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a -DBM MICROVOLTS dial indication of 1K on the microvolts scale.

ah. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1,000 on the RF UV scale.

ai. Depress that combination of input attenuator push-buttons which permitted the first indication of the reception of an r-f signal as indicated by the output meter (see step s, above).

aj. Set the FUNCTION SEL switch to the OPERATE position.

ak. Note the output meter pointer deflection. This corresponds to the value of a cw signal whose peak level is the same as the average value of the narrowband r-f signal under measurement. To determine the numerical value of this indication, use the conversion charts supplied in tables 2-3, 2-4, and 2-5. These charts employ the input attenuation as a parameter.

2-13. DIRECT R-F SUBSTITUTION TECHNIQUE. To determine the average value of a narrowband r-f signal by the direct r-f substitution technique, proceed as outlined in paragraph 2-12, steps a through ai. Then proceed as outlined in the following additional steps.

NOTE:

The direct r-f substitution technique is applicable only when the narrowband r-f signal level is less than or equal to the maximum output level of the signal calibrator (0 dbm).

- a. Set the FUNCTION SEL switch to OPERATE.
- b. Adjust the IF GAIN control to position the output meter pointer directly over the nearest reference mark on the DB ABOVE 1 UV scale.
- c. Set the FUNCTION SEL switch to CAL SIG GEN.
- d. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain the same reading as in step b, above.
- e. Note the -DBM MICROVOLTS dial indication on the microvolts scale. This indication is the value of a cw signal whose peak level has the same average value as the narrowband signal under measurement.

2-13A. MODIFIED R-F SUBSTITUTION TECHNIQUE. To determine the average value of narrowband r-f signals by the modified r-f substitution technique, proceed as outlined in paragraph 2-12, steps a through ai. Then proceed as outlined in the following additional steps.

NOTE:

The modified r-f substitution technique is applicable for measurement of narrowband r-f signals between the levels of 0 dbm (the maximum output level of the signal calibrator) and 3 volts (the maximum r-f input level for the FIM-2 determined by power dissipation considerations).

- a. Set the FUNCTION SEL switch to CAL SIG GEN.
- b. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain the same output meter pointer deflection as in paragraph 2-12, step s.

TABLE 2-3. OUTPUT METER RF μ V SCALE CONVERSION CHART.

Output Meter RF μ V Scale Indication	RMS VALUE OF CW SIGNAL WHICH PRODUCES THE SAME OUTPUT METER POINTER DEFLECTION																										
	60 Db R-f Attenuation 20 Db I-f Attenuation			60 Db R-f Attenuation 10 Db I-f Attenuation			60 Db R-f Attenuation 0 Db I-f Attenuation			40 Db R-f Attenuation 10 Db I-f Attenuation			40 Db R-f Attenuation 0 Db I-f Attenuation			20 Db R-f Attenuation 10 Db I-f Attenuation			20 Db R-f Attenuation 0 Db I-f Attenuation			0 Db R-f Attenuation 10 Db I-f Attenuation			0 Db R-f Attenuation 0 Db I-f Attenuation		
	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm	μ V	Db Above 1μ V	Dbm
10	100 K	100.0	-7.0	31.7 K	90.0	-17.0	10 K	80.0	-27.0	3.17 K	70.0	-37.0	1 K	60.0	-47.0	317	50.0	-57.0	100	40.0	-67.0	31.7	30.0	-77.0	10	20.0	-87.0
20	200 K	106.0	-1.0	63.4 K	96.0	-11.0	20 K	86.0	-21.0	6.34 K	76.0	-31.0	2 K	66.0	-41.0	634	56.0	-51.0	200	46.0	-61.0	63.4	36.0	-71.0	20	26.0	-81.0
30	300 K	109.5	+2.5	95.1 K	99.5	-7.5	30 K	89.5	-17.5	9.51 K	79.5	-27.5	3 K	69.5	-37.5	951	59.5	-47.5	300	49.5	-57.5	95.1	39.5	-67.5	30	29.5	-77.5
40	400 K	112.0	+5.0	127 K	102.0	-5.0	40 K	92.0	-15.0	12.7 K	82.0	-25.0	4 K	72.0	-35.0	1.27 K	62.0	-45.0	400	52.0	-55.0	127	42.0	-65.0	40	32.0	-75.0
50	500 K	114.0	+7.0	159 K	104.0	-3.0	50 K	94.0	-13.0	15.9 K	84.0	-23.0	5 K	74.0	-33.0	1.59 K	64.0	-43.0	500	54.0	-53.0	159	44.0	-63.0	50	34.0	-73.0
60	600 K	115.5	+8.5	190 K	105.5	-1.5	60 K	95.5	-11.5	19.0 K	85.5	-21.5	6 K	75.5	-31.5	1.90 K	65.5	-41.5	600	55.5	-51.5	190	45.5	-61.5	60	35.5	-71.5
70	700 K	116.9	+9.9	222 K	106.9	-0.1	70 K	96.9	-10.1	22.2 K	86.9	-20.1	7 K	76.9	-30.1	2.22 K	66.9	-40.1	700	56.9	-50.1	222	46.9	-60.1	70	36.9	-70.1
80	800 K	118.0	+11.0	254 K	108.0	+1.0	80 K	98.0	-9.0	25.4 K	88.0	-19.0	8 K	78.0	-29.0	2.54 K	68.0	-39.0	800	58.0	-49.0	254	48.0	-59.0	80	38.0	-69.0
90	900 K	119.1	+12.1	285 K	109.1	+2.1	90 K	99.1	-7.9	28.5 K	89.1	-17.9	9 K	79.1	-27.9	2.85 K	69.1	-37.9	900	59.1	-47.9	285	49.1	-57.9	90	39.1	-67.9
100	1.0 volt	120.0	+13.0	317 K	110.0	+3.0	100 K	100.0	-7.0	31.7 K	90.0	-17.0	10 K	80.0	-27.0	3.17 K	70.0	-37.0	1.0 K	60.0	-47.0	317	50.0	-57.0	100	40.0	-67.0
120	1.2 volts	121.5	+14.5	380 K	111.5	+4.5	120 K	101.5	-5.5	38.0 K	91.5	-15.5	12 K	81.5	-25.5	3.80 K	71.5	-35.5	1.2 K	61.5	-45.5	380	51.5	-55.5	120	41.5	-65.5
140	1.4 volts	122.9	+15.9	444 K	112.9	+5.9	140 K	102.9	-4.1	44.4 K	92.9	-14.1	14 K	82.9	-24.1	4.44 K	72.9	-34.1	1.4 K	62.9	-44.1	444	52.9	-54.1	140	42.9	-64.1
160	1.6 volts	124.0	+17.0	508 K	114.0	+7.0	160 K	104.0	-3.0	50.8 K	94.0	-13.0	16 K	84.0	-23.0	5.08 K	74.0	-33.0	1.6 K	64.0	-43.0	508	54.0	-53.0	160	44.0	-63.0
180	1.8 volts	125.1	+18.1	570 K	115.1	+8.1	180 K	105.1	-1.9	57.0 K	95.1	-11.9	18 K	85.1	-21.9	5.70 K	75.1	-31.9	1.8 K	65.1	-41.9	570	55.1	-51.9	180	45.1	-61.9
200	2 volts	126.0	+19.0	634 K	116.0	+9.0	200 K	106.0	-1.0	63.4 K	96.0	-11.0	20 K	86.0	-21.0	6.34 K	76.0	-31.0	2.0 K	66.0	-41.0	634	56.0	-51.0	200	46.0	-61.0
300	3 volts	129.5	+22.5	951 K	119.5	+12.5	300 K	109.5	+2.5	95.1 K	99.5	-7.5	30 K	89.5	-17.5	9.51 K	79.5	-27.5	3.0 K	69.5	-37.5	951	59.5	-47.5	300	49.5	-57.5
400	4 volts	132.0	+25.0	1.27 volts	122.0	+15.0	400 K	112.0	+5.0	127 K	102.0	-5.0	40 K	92.0	-15.0	12.7 K	82.0	-25.0	4.0 K	72.0	-35.0	1.27 K	62.0	-45.0	400	52.0	-55.0
500	5 volts	134.0	+27.0	1.59 volts	124.0	+17.0	500 K	114.0	+7.0	159 K	104.0	-3.0	50 K	94.0	-13.0	15.9 K	84.0	-23.0	5.0 K	74.0	-33.0	1.59 K	64.0	-43.0	500	54.0	-53.0
600	6 volts	135.5	+28.5	1.90 volts	125.5	+18.5	600 K	115.5	+8.5	190 K	105.5	-1.5	60 K	95.5	-11.5	19.0 K	85.5	-21.5	6.0 K	75.5	-31.5	1.90 K	65.5	-41.5	600	55.5	-51.5
700	7 volts	136.9	+29.9	2.22 volts	126.9	+19.9	700 K	116.9	+9.9	222 K	106.9	-0.1	70 K	96.9	-10.1	22.2 K	86.9	-20.1	7.0 K	76.9	-30.1	2.22 K	66.9	-40.9	700	56.9	-50.9
800	8 volts	138.0	+31.0	2.54 volts	128.0	+21.0	800 K	118.0	+11.0	254 K	108.0	+1.0	80 K	98.0	-9.0	25.4 K	88.0	-19.0	8.0 K	78.0	-29.0	2.54 K	68.0	-39.0	800	58.0	-49.0
900	9 volts	139.1	+32.1	2.85 volts	129.1	+22.1	900 K	119.1	+12.1	285 K	109.1	+2.1	90 K	99.1	-7.9	28.5 K	89.1	-17.9	9.0 K	79.1	-27.9	2.85 K	69.1	-37.9	900	59.1	-47.9
1000	10 volts	140.0	+33.0	3.17 volts	130.0	+23.0	1 volt	120.0	+13.0	317 K	110.0	+3.0	100 K	90.0	-7.0	3.17 K	80.0	-17.0	10 K	70.0	-27.0	3.17 K	70.0	-37.0	1 K	60.0	-47.0

USE OF CONVERSION CHART:

1. Note output meter pointer deflection.
2. Note r-f and i-f attenuation inserted.
3. Follow appropriate row in Output Meter RF μ V Scale Indication column to obtain rms value of cw signal which produces the same deflection, as listed in μ V, db above 1μ V, and dbm in the appropriate attenuation column.

NOTE:

SHADED PORTION OF TABLE DENOTES VALUES OF INPUT SIGNALS BEYOND CAPABILITY OF FIM-2.

TABLE 2-4. OUTPUT METER DB ABOVE 1μV SCALE CONVERSION CHART.

Output Meter DB ABOVE 1μV Scale Indication	RMS VALUE OF CW SIGNAL WHICH PRODUCES THE SAME OUTPUT METER POINTER DEFLECTION.																										
	60 Db R-f Attenuation 20 Db I-f Attenuation			60 Db R-f Attenuation 10 Db I-f Attenuation			60 Db R-f Attenuation 0 Db I-f Attenuation			40 Db R-f Attenuation 10 Db I-f Attenuation			40 Db R-f Attenuation 0 Db I-f Attenuation			20 Db R-f Attenuation 10 Db I-f Attenuation			20 Db R-f Attenuation 0 Db I-f Attenuation			0 Db R-f Attenuation 10 Db I-f Attenuation			0 Db R-f Attenuation 0 Db I-f Attenuation		
	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm	Db Above 1μV	μV	Dbm
20	100	100K	-7	90	31.7K	-17	80	10K	-27	70	3.17K	-37	60	1K	-47	50	317	-57	40	100	-67	30	31.7	-77	20	10.0	-87
21	101	112K	-6	91	35.5K	-16	81	11.2K	-26	71	3.55K	-36	61	1.12K	-46	51	355	-56	41	112	-66	31	35.5	-76	21	11.2	-86
22	102	126K	-5	92	40.0K	-15	82	12.6K	-25	72	4.00K	-35	62	1.26K	-45	52	400	-55	42	126	-65	32	40.0	-75	22	12.6	-85
23	103	141K	-4	93	44.6K	-14	83	14.1K	-24	73	4.46K	-34	63	1.41K	-44	53	446	-54	43	141	-64	33	44.6	-74	23	14.1	-84
24	104	159K	-3	94	50.1K	-13	84	15.9K	-23	74	5.01K	-33	64	1.59K	-43	54	501	-53	44	159	-63	34	50.1	-73	24	15.9	-83
25	105	178K	-2	95	56.2K	-12	85	17.8K	-22	75	5.62K	-32	65	1.78K	-42	55	562	-52	45	178	-62	35	56.2	-72	25	17.8	-82
26	106	200K	-1	96	63.1K	-11	86	20.0K	-21	76	6.31K	-31	66	2.00K	-41	56	631	-51	46	200	-61	36	63.1	-71	26	20.0	-81
27	107	224K	0	97	71.0K	-10	87	22.4K	-20	77	7.10K	-30	67	2.24K	-40	57	710	-50	47	224	-60	37	71.0	-70	27	22.4	-80
28	108	252K	+1	98	80.0K	-9	88	25.2K	-19	78	8.00K	-29	68	2.52K	-39	58	800	-49	48	252	-59	38	80.0	-69	28	25.2	-79
29	109	282K	+2	99	89.2K	-8	89	28.2K	-18	79	8.92K	-28	69	2.82K	-38	59	892	-48	49	282	-58	39	89.2	-68	29	28.2	-78
30	110	317K	+3	100	100K	-7	90	31.7K	-17	80	10.0K	-27	70	3.17K	-37	60	1K	-47	50	317	-57	40	100	-67	30	31.7	-77
31	111	355K	+4	101	112K	-6	91	35.5K	-16	81	11.2K	-26	71	3.55K	-36	61	1.12K	-46	51	355	-56	41	112	-66	31	35.5	-76
32	112	400K	+5	102	126K	-5	92	40.0K	-15	82	12.6K	-25	72	4.00K	-35	62	1.26K	-45	52	400	-55	42	126	-65	32	40.0	-75
33	113	446K	+6	103	141K	-4	93	44.6K	-14	83	14.1K	-24	73	4.46K	-34	63	1.41K	-44	53	446	-54	43	141	-64	33	44.6	-74
34	114	501K	+7	104	159K	-3	94	50.1K	-13	84	15.9K	-23	74	5.01K	-33	64	1.59K	-43	54	501	-53	44	159	-63	34	50.1	-73
35	115	562K	+8	105	178K	-2	95	56.2K	-12	85	17.8K	-22	75	5.62K	-32	65	1.78K	-42	55	562	-52	45	178	-62	35	56.2	-72
36	116	631K	+9	106	200K	-1	96	63.1K	-11	86	20.0K	-21	76	6.31K	-31	66	2.00K	-41	56	631	-51	46	200	-61	36	63.1	-71
37	117	710K	+10	107	224K	0	97	71.0K	-10	87	22.4K	-20	77	7.10K	-30	67	2.24K	-40	57	710	-50	47	224	-60	37	71.0	-70
38	118	800K	+11	108	252K	+1	98	80.0K	-9	88	25.2K	-19	78	8.00K	-29	68	2.52K	-39	58	800	-49	48	252	-59	38	80.0	-69
39	119	892K	+12	109	282K	+2	99	89.2K	-8	89	28.2K	-18	79	8.92K	-28	69	2.82K	-38	59	892	-48	49	282	-58	39	89.2	-68
40	120	11 volt	+13	110	317K	+3	100	100K	-7	90	31.7K	-17	80	10K	-27	70	3.17K	-37	60	1K	-47	50	317	-57	40	100	-67
41	121	1.12 volts	+14	111	355K	+4	101	112K	-6	91	35.5K	-16	81	11.2K	-26	71	3.55K	-36	61	1.12K	-46	51	355	-56	41	112	-66
42	122	1.26 volts	+15	112	400K	+5	102	126K	-5	92	40.0K	-15	82	12.6K	-25	72	4.00K	-35	62	1.26K	-45	52	400	-55	42	126	-65
43	123	1.41 volts	+16	113	446K	+6	103	141K	-4	93	44.6K	-14	83	14.1K	-24	73	4.46K	-34	63	1.41K	-44	53	446	-54	43	141	-64
44	124	1.59 volts	+17	114	501K	+7	104	159K	-3	94	50.1K	-13	84	15.9K	-23	74	5.01K	-33	64	1.59K	-43	54	501	-53	44	159	-63
45	125	1.78 volts	+18	115	562K	+8	105	178K	-2	95	56.2K	-12	85	17.8K	-22	75	5.62K	-32	65	1.78K	-42	55	562	-52	45	178	-62
46	126	2.00 volts	+19	116	631K	+9	106	200K	-1	96	63.1K	-11	86	20.0K	-21	76	6.31K	-31	66	2.00K	-41	56	631	-51	46	200	-61
47	127	2.24 volts	+20	117	710K	+10	107	224K	0	97	71.0K	-10	87	22.4K	-20	77	7.10K	-30	67	2.24K	-40	57	710	-50	47	224	-60
48	128	2.52 volts	+21	118	800K	+11	108	252K	+1	98	80.0K	-9	88	25.2K	-19	78	8.00K	-29	68	2.52K	-39	58	800	-49	48	252	-59
49	129	2.82 volts	+22	119	892K	+12	109	282K	+2	99	89.2K	-8	89	28.2K	-18	79	8.92K	-28	69	2.82K	-38	59	892	-48	49	282	-58
50	130	3.17 volts	+23	120	1 volt	+13	110	317K	+3	100	100K	-7	90	31.7K	-17	80	10K	-27	70	3.17K	-37	60	1K	-47	50	317	-57
51	131	3.55 volts	+24	121	1.12 volts	+14	111	355K	+4	101	112K	-6	91	35.5K	-16	81	11.2K	-26	71	3.55K	-36	61	1.12K	-46	51	355	-56
52	132	4.00 volts	+25	122	1.26 volts	+15	112	400K	+5	102	126K	-5	92	40.0K	-15	82	12.6K	-25	72	4.00K	-35	62	1.26K	-45	52	400	-55
53	133	4.46 volts	+26	123	1.41 volts	+16	113	446K	+6	103	141K	-4	93	44.6K	-14	83	14.1K	-24	73	4.46K	-34	63	1.41K	-44	53	446	-54
54	134	5.01 volts	+27	124	1.59 volts	+17	114	501K	+7	104	159K	-3	94	50.1K	-13	84	15.9K	-23	74	5.01K	-33	64	1.59K	-43	54	501	-53
55	135	5.62 volts	+28	125	1.78 volts	+18	115	562K	+8	105	178K	-2	95	56.2K	-12	85	17.8K	-22	75	5.62K	-32	65	1.78K	-42	55	562	-52
56	136	6.31 volts	+29	126	2.00 volts	+19	116	631K	+9	106	200K	-1	96	63.1K	-11	86	20.0K	-21	76	6.31K	-31	66	2.00K	-41	56	631	-51
57	137	7.10 volts	+30	127	2.24 volts	+20	117	710K	+10	107	224K	0	97	71.0K	-10	87	22.4K	-20	77	7.10K	-30	67	2.24K	-40	57	710	-60
58	138	8.00 volts	+31	128	2.52 volts	+21	118	800K	+11	108	252K	+1	98	80.0K	-9	88	25.2K	-19	78	8.00K	-29	68	2.52K	-39	58	800	-49
59	139	8.92 volts	+32	129	2.82 volts	+22	119	892K	+12	109	282K	+2	99	89.2K	-8	89	28.2K	-18	79	8.92K	-28	69	2.82K	-38	59	892	-48
60	140	10.0 volts	+33	130	3.17 volts	+23	120	1 volt	+13	110	317K	+3	100	100K	-7	90	31.7K	-17	80	10K	-27	70	3.17K	-37	60	1K	-47

USE OF CONVERSION CHART:

1. Note output meter pointer deflection.
2. Note r-f and i-f attenuation inserted.
3. Follow appropriate row in Output Meter DB ABOVE 1μV Scale Indication column to obtain rms value of cw signal which produces the same deflection, as listed in db above 1μV, μV, and dbm in the appropriate attenuation column.

NOTE: SHADED PORTION OF TABLE DENOTES VALUES OF INPUT SIGNALS BEYOND CAPABILITY OF FM-2.

TABLE 2-5. OUTPUT METER DB ABOVE $1\mu\text{V}/\text{MC}$ SCALE CONVERSION CHART.

Output Meter DB ABOVE $1\mu\text{V}/\text{MC}$ Scale Indication	RMS VALUE OF CW SIGNAL WHICH PRODUCES SAME OUTPUT METER POINTER DEFLECTION																	
	60Db R-f Atten 20Db I-f Atten		60Db R-f Atten 10Db I-f Atten		60Db R-f Atten 0Db I-f Atten		40Db R-f Atten 10Db I-f Atten		40Db R-f Atten 0Db I-f Atten		20Db R-f Atten 10Db I-f Atten		20Db R-f Atten 0Db I-f Atten		0Db R-f Atten 10Db I-f Atten		0Db R-f Atten 0Db I-f Atten	
	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV	DB ABOVE $1\mu\text{V}/\text{MC}$	μV
5	85	89K	75	28K	65	8.9K	55	2.80K	45	890	35	280	25	89	15	28	5	8.9
10	90	158K	80	50K	70	15.8K	60	5.00K	50	1.58K	40	500	30	158	20	50	10	15.8
15	95	280K	85	89K	75	28.0K	65	8.90K	55	2.80K	45	890	35	280	25	89	15	28.0
20	100	500K	90	158K	80	50.0K	70	15.8K	60	5.00K	50	1.58K	40	500	30	158	20	50.0
25	105	890K	95	280K	85	89.0K	75	28.0K	65	8.90K	55	2.80K	45	890	35	280	25	89.0
30	110	1.58M	100	500K	90	158K	80	50.0K	70	15.8K	60	5.00K	50	1.58K	40	500	30	158
35	115	2.8M	105	890K	95	280K	85	89.0K	75	28.0K	65	8.90K	55	2.80K	45	890	35	280
40	120	5.0M	110	1.58M	100	500K	90	158K	80	50.0K	70	15.8K	60	5.0K	50	1.580	40	500
45	125	8.9M	115	2.89M	105	890K	95	280K	85	89.0K	75	50.0K	65	8.9K	55	2.800	45	290

USE OF CONVERSION CHART:

1. Note output meter pointer deflection.
2. Note r-f and i-f attenuation inserted.
3. Follow appropriate row in Output Meter DB ABOVE $1\mu\text{V}/\text{MC}$ Scale Indication column to obtain rms value of cw signal which produces the same deflection, as listed in db above $1\mu\text{V}/\text{mc}$ and μV in the appropriate attenuation column.

NOTE:

SHADED PORTION OF TABLE DENOTES VALUES OF INPUT SIGNALS BEYOND CAPABILITY OF FIM-2.

NOTE:

If the output meter pointer deflection of paragraph 2-12, step s, cannot be obtained, remove r-f attenuation in 20-db steps and repeat step b, above.

c. Note the amount of r-f attenuation removed.

d. Note the -DBM MICROVOLTS dial indication on the -dbm scale.

e. The average value of the narrowband r-f signal under measurement is equal to the -DBM MICROVOLTS dial indication (in -dbm) plus the amount of r-f attenuation removed (in db).

2-14. MEASURING THE QUASI-PEAK VALUE OF R-F SIGNALS.

2-15. The QUASI-PEAK position of the OUTPUT switch is used to determine the nuisance value of an interference. It can be used to detect the presence of either broadband or narrowband r-f signals. The greater the prf of the signal under measurement, the greater the output meter indication (for a given signal amplitude). Further evaluation of the r-f signal can be obtained through the use of the AVERAGE and PEAK positions of the OUTPUT switch.

2-16. To determine the quasi-peak value of r-f signals, proceed as outlined in paragraph 2-12, steps a through ai. Then proceed as outlined in the following steps.

a. Set the OUTPUT switch to the QUASI-PEAK position.

b. Note the output meter pointer deflection. The value of a cw signal whose peak level is the same as the quasi-peak value of the signal under measurement can be obtained with the aid of the conversion charts supplied in tables 2-3, 2-4, and 2-5.

2-16. MEASURING THE PEAK VALUE OF R-F SIGNALS BY THE SLIDEBACK TECHNIQUE.

2-17. The SLIDEBACK position of the OUTPUT switch can be used to determine the peak value of broadband (pulsed) signals by the slideback technique. The output meter indication will be the value of a cw signal whose peak level is equal to that of the r-f signal under measurement.

2-18. To determine the peak value of r-f signals by the slideback technique, proceed as outlined in paragraph 2-12, steps a through al. Then proceed as outlined in the following additional steps.

- a. Set the OUTPUT switch to SLIDEBACK.
- b. Rotate the SLIDEBACK control fully counterclockwise.
- c. Note the aural indication obtained in the headset.
- d. Rotate the SLIDEBACK control clockwise, causing the aural indication to decrease in strength. As the signal strength decreases, rotate the AUDIO GAIN control clockwise. Continue rotating the SLIDEBACK control clockwise until the aural indication can no longer be heard in the headset.
- e. Note the output meter pointer indication. This is the level of a cw signal having the same peak value as the r-f signal under measurement. See the conversion charts listed in tables 2-3, 2-4, and 2-5.

2-18. MEASURING THE PEAK VALUE OF R-F SIGNALS.

2-19. The PEAK position of the OUTPUT switch, like the SLIDEBACK

position, is used to determine the peak value of either narrowband or broadband signals. The output meter pointer deflection will correspond to the value of a cw signal whose peak level is equal to that of the r-f signal under measurement.

2-19. To determine the peak value of r-f signals, proceed as outlined in paragraph 2-12, steps a through ai. Then proceed as outlined in the following steps.

a. Set the OUTPUT switch to the PEAK position.

b. Note the output meter pointer deflection. The actual value of a cw signal having the same peak level as the signal under measurement can be obtained with the aid of the scale conversion charts supplied in tables 2-3, 2-4, and 2-5.

2-20. MEASURING ATTENUATOR CHARACTERISTICS.

2-21. The three basic methods for measurement of r-f attenuation (i-f substitution method, r-f substitution method, and calibrated signal generator method) are described below in paragraphs 2-22, 2-23, and 2-24, respectively.

2-22. I-F SUBSTITUTION METHOD. To determine the attenuation of an r-f attenuator using the i-f substitution method, proceed as outlined in the following steps.

NOTE:

This method is valid only when the insertion loss of the r-f attenuator under test is less than 20 db.

a. Apply operating power to the FIM-2 as outlined in paragraph 2-7, steps b through d.

b. Connect r-f cable assembly W1205 as a jumper between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-12.

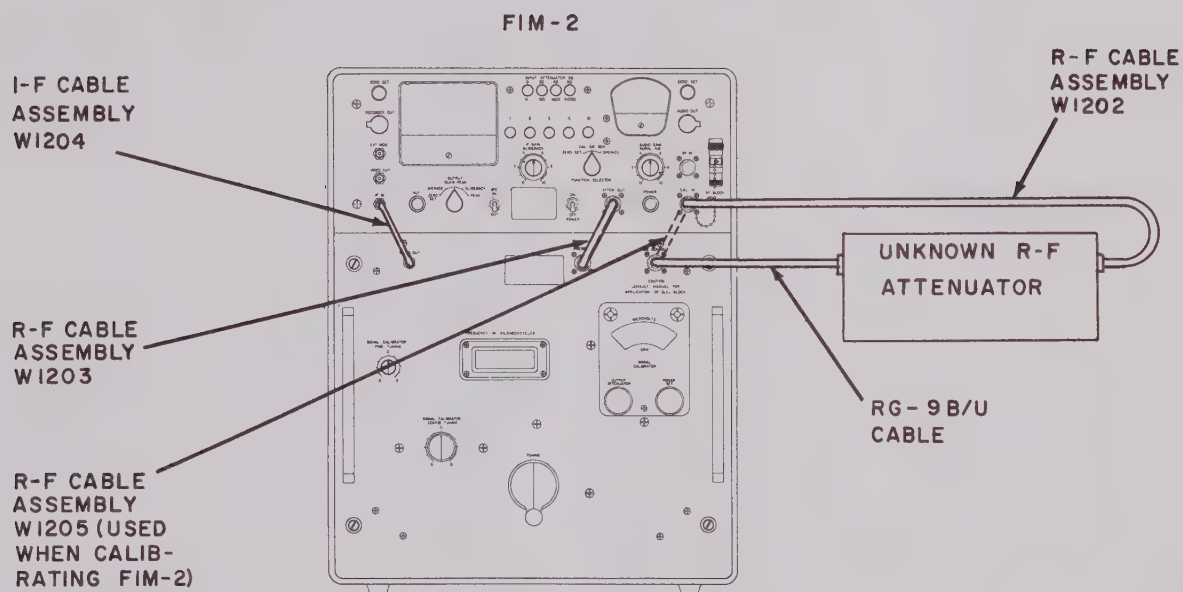


Figure 2-12. Attenuator Measurements Using I-f Substitution Method, Equipment Set Up

c. Connect r-f cable assembly W1203 as a jumper between the ATTEN OUT jack and the PRESEL IN jack, as shown in figure 2-12.

d. Connect i-f cable assembly W1204 as a jumper between the MIXER OUT jack and the IF IN jack, as shown in figure 2-12.

e. Depress the r-f INPUT ATTENUATOR DB push-button switch marked OX1.

f. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.

g. Set the AFC switch to the OUT position.

h. Rotate the TUNING control to the desired operating frequency, as indicated on the FREQUENCY IN KILOMEGACYCLES dial.

i. Set the FUNCTION SEL switch to the ZERO SET position.

j. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

k. Set the OUTPUT switch to the ZERO SET position.

l. Adjust the output meter ZERO SET control to zero-set the output meter pointer.

m. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.

n. Set the FUNCTION SEL switch to the CAL SIG GEN position.

o. Set the OUTPUT switch to the AVERAGE position.

p. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to an indication of 0.

q. Rotate the SIGNAL CALIBRATOR FINE TUNING control to an indication of 0.

r. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection corresponding to "cal," as indicated on the correction curves supplied with the Tuning Unit in use.

s. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of approximately 100 on the RF UV scale.

t. Adjust the SIGNAL CALIBRATOR COARSE TUNING control to obtain maximum deflection of the output meter pointer.

u. Adjust the SIGNAL CALIBRATOR FINE TUNING control to peak the deflection of the output meter pointer.

v. Readjust the SIGNAL CALIBRATOR POWER SET control, if necessary, to maintain a power monitor meter pointer deflection corresponding to "cal."

w. Rotate the IF GAIN control fully counterclockwise.

x. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a -DBM MICROVOLTS dial indication of 1K on the microvolts scale.

y. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

z. Interpose the r-f attenuator under test between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-12.

aa. Adjust the IF GAIN control to position the output meter pointer directly above the nearest reference mark on the DB ABOVE 1 UV scale. Note this indication.

ab. Remove the r-f attenuator and replace r-f cable assembly W1205 between the SIG GEN OUT jack and the CAL IN jack.

ac. Depress the i-f Input Attenuator Db push-button switches (either individually or in groups) until the reference deflection of step aa, above, is obtained.

ad. The insertion loss, in db, of the r-f attenuator under test is equal to the sum of the panel markings above those i-f Input Attenuator Db push-button switches depressed (within 0.1 db/db).

2-23. R-F SUBSTITUTION METHOD. To determine the insertion loss of an r-f attenuator by the r-f substitution method, proceed as outlined in paragraph 2-22, steps a through y. Then proceed as outlined in the following steps.

NOTE:

This method is valid only when the insertion loss of the r-f attenuator under test is less than 80 db.

a. Interpose the r-f attenuator under test between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-13.

b. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a reference deflection on the output meter DB ABOVE 1 UV scale.

c. Replace the r-f attenuator under test with a calibrated r-f attenuator capable of inserting at least 80 db of attenuation, as shown in figure 2-13. Adjust the calibrated r-f attenuator for maximum insertion loss.

d. Adjust the calibrated r-f attenuator to obtain the output meter deflection of step b, above.

e. The insertion loss of the r-f attenuator under test is equal to that of the calibrated r-f attenuator.

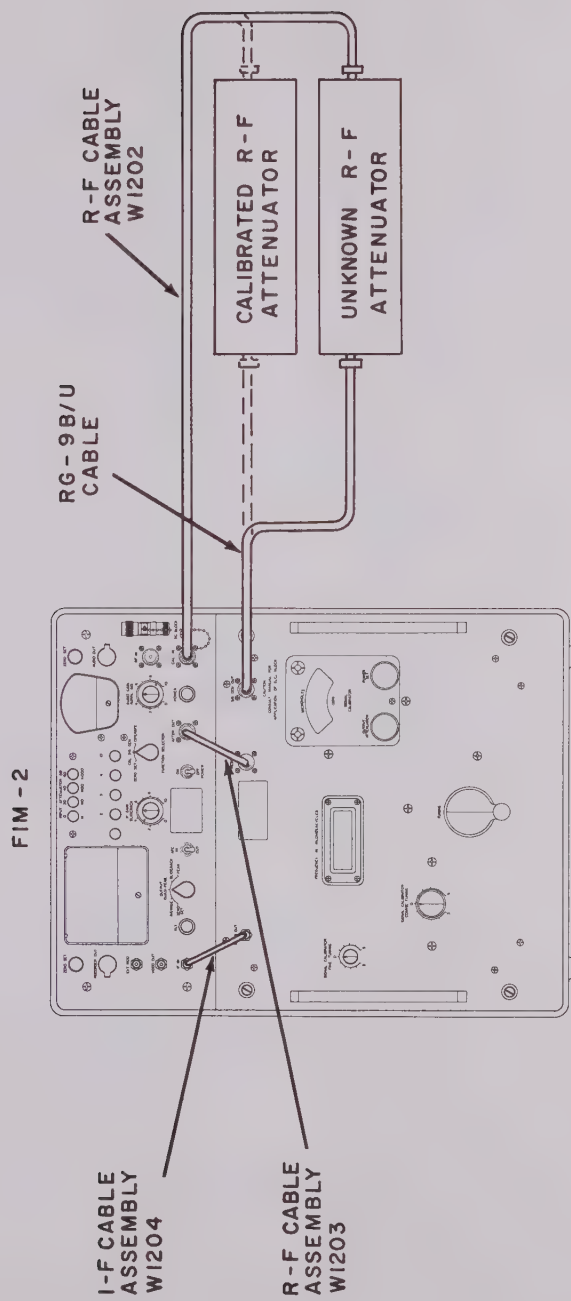


Figure 2-13. Attenuator Measurements Using R-f Substitution Method, Equipment Set Up

2-24. CALIBRATED SIGNAL GENERATOR METHOD. To determine the insertion loss of an r-f attenuator by the calibrated signal generator method, proceed as outlined in paragraph 2-22, steps a through v. Then proceed as outlined in the following steps.

NOTE:

This method is valid only when the insertion loss of the r-f attenuator under measurement is less than 80 db.

- a. Interpose the r-f attenuator under test between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-12.
- b. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a reference deflection of the output meter pointer at the low end of the DB ABOVE 1 UV scale.
- c. Note the -DBM MICROVOLTS dial indication on the -dbm scale.
- d. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.
- e. Remove the r-f attenuator under test and replace r-f cable assembly W1205 between the SIG GEN OUT jack and the CAL IN jack.
- f. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain the same output meter pointer deflection as in step b, above.
- g. Note the -DBM MICROVOLTS dial indication on the -dbm scale.
- h. The attenuation, in db, of the r-f attenuator under test is equal to the difference between the -DBM MICROVOLTS dial indications.

2-25. GAIN CHARACTERISTICS.

2-26. To determine the small-signal gain characteristics of microwave devices, such as a traveling wave tube amplifier, proceed as outlined in paragraph 2-22, steps a through y. Then proceed as outlined in the following steps.

a. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a -DBM MICROVOLTS dial indication of 50 on the microvolts scale.

b. Connect the input of the microwave device to the SIG GEN OUT jack, as shown in figure 2-14.

c. Connect the output of the microwave device to the CAL IN jack, as shown in figure 2-14.

d. Depress the r-f INPUT ATTENUATOR DB push-button switch marked 60X1000.

e. Note the output meter pointer deflection. If there is no indication, depress the next lower r-f INPUT ATTENUATOR DB push-button switch until an on-scale deflection is obtained. Note this deflection.

f. Remove the microwave device from between the SIG GEN OUT jack and the CAL IN jack and replace r-f cable assembly W1205.

g. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain the same output meter pointer deflection as in step e, above.

h. Note the -DBM MICROVOLTS dial indication on the microvolts scale.

i. The gain of the microwave device, in db, is equal to

$$A = 20 \log_{10} \frac{\text{Reading of step h (in microvolts)}}{50 \text{ microvolts}}$$

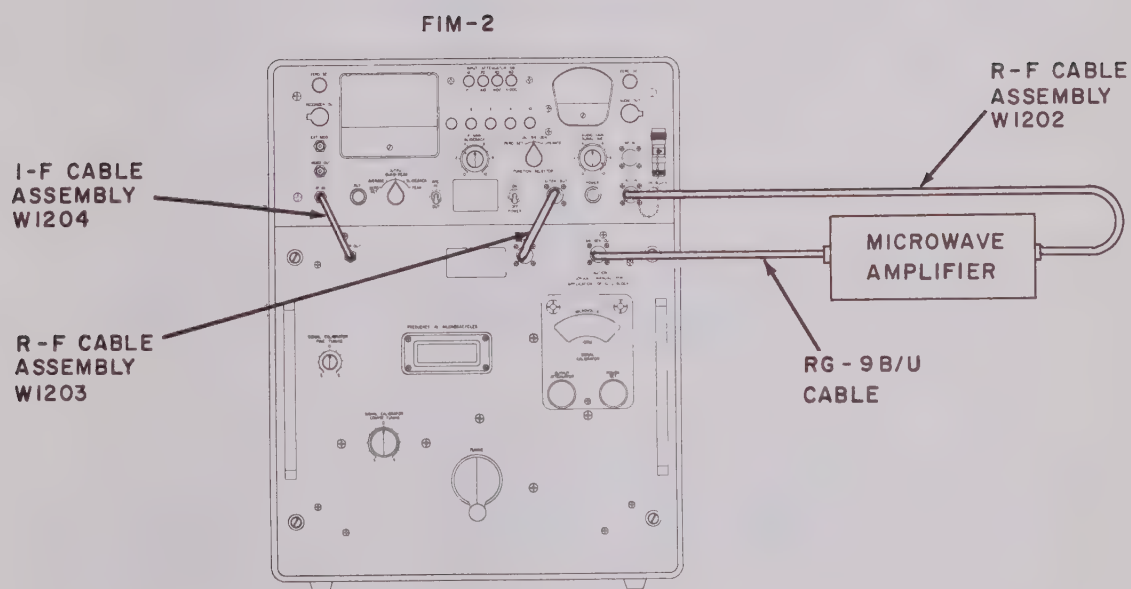


Figure 2-14. Gain Measurements, Equipment Set Up

2-27. VSWR MEASUREMENTS.

2-28. Two methods are available to determine the VSWR of microwave components: one employs the receiver section of the FIM-2; the other employs an external standing wave indicator. The procedures for determining the VSWR of a microwave component using the receiver section of the FIM-2 is outlined in paragraph 2-28A; that using the external standing wave indicator is outlined in paragraph 2-28B.

2-28A. To determine the VSWR of a microwave component using the receiver section of the FIM-2, proceed as outlined in paragraph 2-22, steps a through y. Then proceed as outlined in the following additional steps.

NOTE:

The slotted line referred to in the following steps is of the type that does not contain its own crystal detector.

- a. Connect the input of the slotted line to the SIG GEN OUT jack, as shown in figure 2-15.
- b. Connect the output of the slotted line to the microwave component under test, as shown in figure 2-15.
- c. Connect the slotted line probe output to the CAL IN jack, as shown in figure 2-15.
- d. Set the OUTPUT switch to PEAK.
- e. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain any desired power level, as indicated on the -DBM MICRO-VOLTS dial.

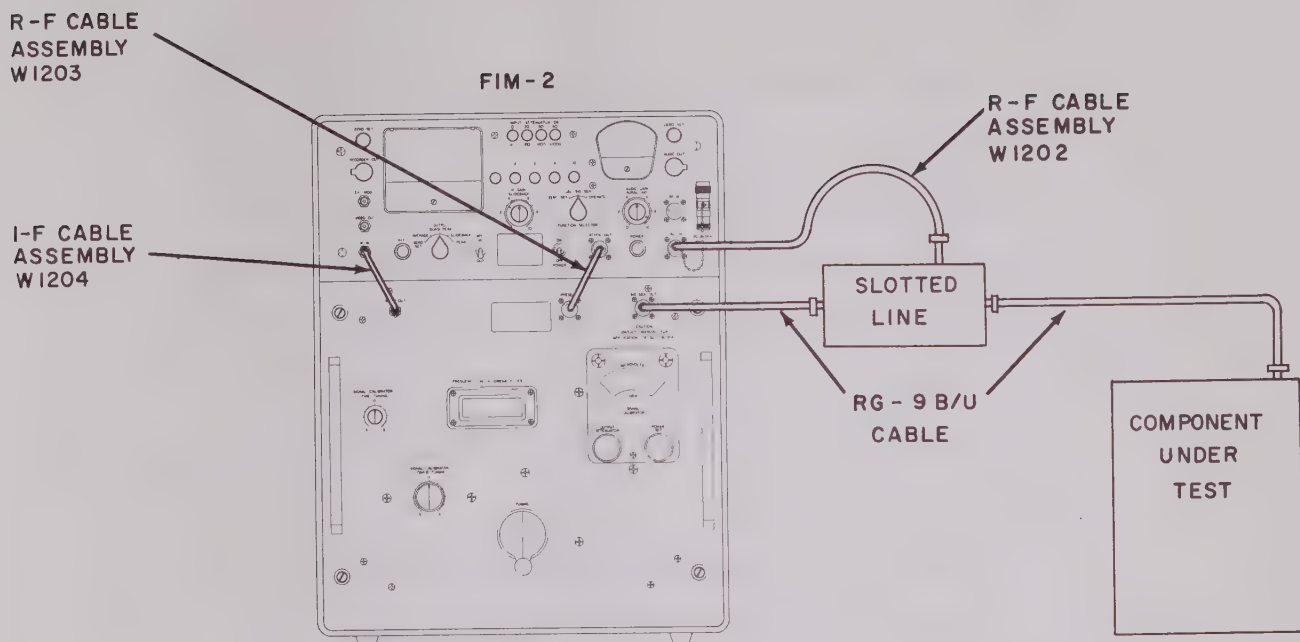


Figure 2-15. VSWR Measurements Using Receiver Section of FIM-2, Equipment Set Up

f. Move the probe along the slotted line until the output meter pointer deflects to a maximum indication.

NOTE:

If the output meter pointer deflects to an off-scale indication, depress the r-f INPUT ATTENUATOR DB push-button switches, in proper sequence, until an on-scale indication is obtained.

g. Note the output meter reading on the DB ABOVE 1 UV scale. Convert this reading to db above one microvolt using the scale conversion chart supplied in table 2-4.

h. Move the probe along the slotted line until the output meter pointer indicates minimum deflection.

i. Note the output meter reading on the DB ABOVE 1 UV scale. Convert this reading to db above one microvolt using the scale conversion chart supplied in table 2-4.

j. The VSWR of the microwave component under test is equal to the difference between the converted readings of steps g and i, and is expressed in db.

2-28B. To determine the VSWR of a microwave component using a standing wave indicator, proceed as outlined in paragraph 2-22, steps a through v. Then proceed as outlined in the following additional steps.

a. Connect a square-wave generator to the EXT MOD jack, as shown in figure 2-15A.

b. Adjust the square-wave generator for a 1,000-cps output at 50 volts peak (100 volts peak-to-peak).

NOTE:

The slotted line referred to in the following steps is of the type that contains its own crystal detector.

c. Connect the input of the slotted line to the SIG GEN OUT jack, as shown in figure 2-15A.

d. Connect the output of the slotted line to the microwave component under test, as shown in figure 2-15A.

e. Connect the slotted line probe output to the input connector of the standing wave indicator, as shown in figure 2-15A.

f. Set the FUNCTION SEL switch to CAL SIG GEN. (For Model FIM-B2 Basic Unit serial numbers 291, 294, 297, 298, 307 to 312, 315, 316, 321, and 322, set the FUNCTION SEL switch to ZERO SET.)

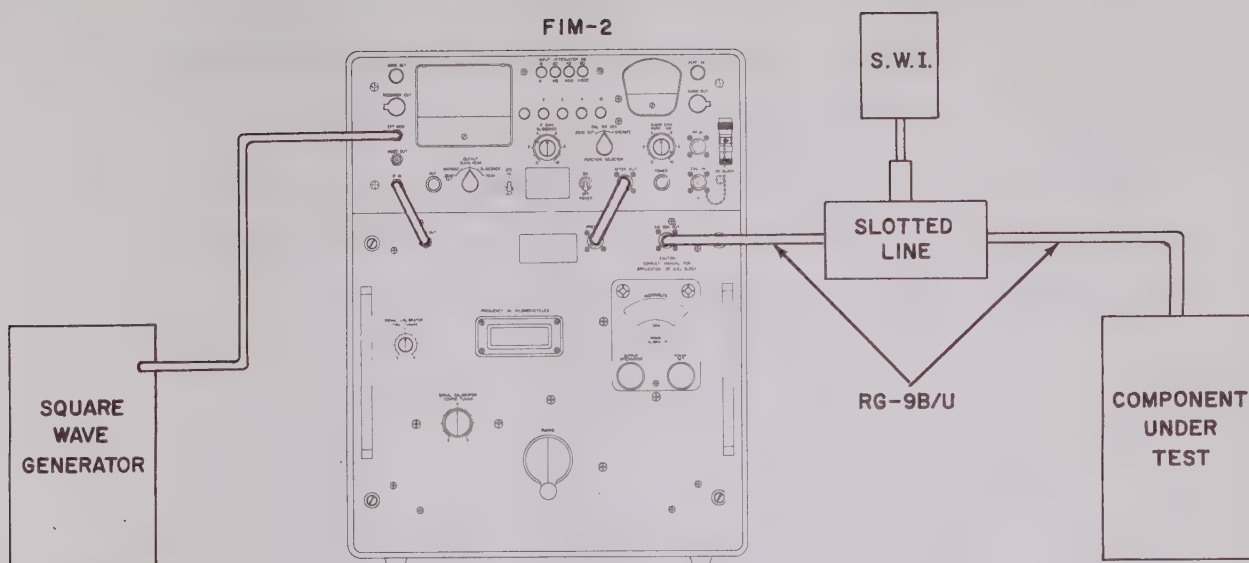


Figure 2-15A. VSWR Measurements Using an External Standing Wave Indicator, Equipment Set Up

- g. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain any desired power level, as indicated on the -DBM MICRO-VOLTS dial.
- h. Move the probe along the slotted line until the standing wave indicator pointer deflects to a maximum indication.
- i. Adjust the standing wave indicator so that the pointer deflects to a full-scale indication.
- j. Move the probe along the slotted line until the standing wave indicator pointer deflects to a minimum indication.
- k. The VSWR of the microwave component under test, in db, is equal to the standing wave indicator pointer indication of step j.

2-29. MICROWAVE FILTER CHARACTERISTICS.

2-30. To determine the insertion loss versus frequency characteristics of microwave filters, use the procedure for measuring the insertion loss of r-f attenuators using the calibrated signal generator method (see paragraph 2-24). Skirt selectivity can be measured up to 80 db below the center frequency response.

2-31. Q AND BANDWIDTH OF MICROWAVE CAVITIES.

2-32. To determine the Q and bandwidth of medium to low Q microwave cavities, proceed as outlined in paragraph 2-22, steps a through y, with the TUNING control adjusted so that the center frequency of the cavity under test is indicated on the FREQUENCY IN KILOMEGACYCLES dial. Then proceed as outlined in the following steps.

a. Depress the r-f INPUT ATTENUATOR DB push-button switch marked 40X100.

b. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 1,000 on the RF UV scale.

c. Interpose the cavity under test between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-16.

d. Note the deflection of the output meter pointer. Determine the corresponding power level of this indication (see tables 2-3, 2-4, and 2-5).

e. Adjust the TUNING control to obtain a FREQUENCY IN KILOMEGACYCLES dial indication which is a small frequency increment away from the cavity center frequency.

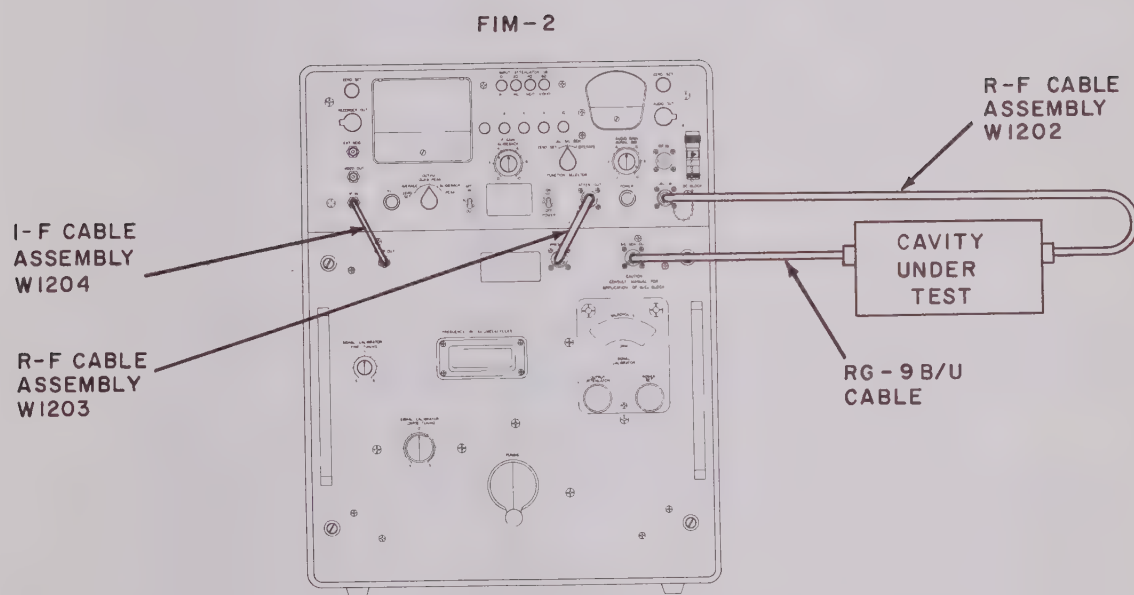


**Figure 2-16. Q and Bandwidth Measurements,
Equipment Set Up**

f. Repeat steps a through y of paragraph 2-22, adjusting the TUNING control to obtain a small frequency displacement from the cavity center frequency.

g. Depress the r-f INPUT ATTENUATOR DB push-button switch marked 40X100.

h. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 1,000 on the RF UV scale.

i. Interpose the cavity under test between the SIG GEN OUT jack and the CAL IN jack, as shown in figure 2-16.

j. Note the deflection of the output meter pointer. Determine the corresponding power level of this indication (see tables 2-4, 2-4, and 2-5).

k. The power response, with respect to the center frequency response, is equal to the difference in power levels between the indications obtained in steps d and j, above.

l. Continue the procedure of steps f through k for further frequency increments, both above and below the center frequency of the cavity, until enough points have been obtained to plot an attenuation versus frequency curve. The bandwidth of the cavity under test can then be determined by finding the points where the power response is 3-db down from the center frequency response. The approximate Q of the cavity can then be determined by the formula

$$Q = \frac{f_o}{\Delta f}$$

where f_o is the center frequency at which the test was conducted and Δf is the 3-db bandwidth of the cavity under test. The highest Q that can be measured with maximum accuracy is

$$Q \leq \frac{f_o}{10BW}$$

where BW = the final i-f bandwidth of the FIM-2 (3 mc).

2-33. NOISE FIGURES OF MICROWAVE AMPLIFIERS.

2-34. To evaluate the noise figure of a microwave amplifier, the gain of the microwave amplifier, the overall noise figure of the microwave amplifier and the FIM-2, and the sensitivity and noise figure of the FIM-2 must first be determined.

2-35. To determine the gain of the microwave amplifier, proceed as outlined in paragraph 2-25.

2-36. To determine the sensitivity of the FIM-2, proceed as outlined in paragraph 2-22, steps a through y. Then proceed as outlined below.

- a. Disconnect r-f cable assembly W1205 from the CAL in jack.
- b. Adjust the IF GAIN control to obtain an output meter pointer deflection of 29 on the DB ABOVE 1 UV scale.
- c. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.
- d. Reconnect r-f cable assembly W1205 to the CAL IN jack.
- e. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 32 on the DB ABOVE 1 UV scale.
- f. Note the -DBM MICROVOLTS dial indication on the -dbm scale. This is the sensitivity of the FIM-2 at the particular frequency of interest.

2-37. To determine the noise figure of the FIM-2, substitute the sensitivity (see paragraph 2-36) into the following equation

$$F_R = 109.24 - \text{Sensitivity of FIM-2 (in -dbm)}$$

where F_R = the noise figure of the FIM-2, in db.

2-38. To determine the overall noise figure of the microwave amplifier and the FIM-2, proceed as outlined in paragraph 2-22, steps a through y. Then proceed as outlined in the following steps.

- a. Remove r-f cable assembly W1205 from the CAL IN jack.
- b. Connect the output of the microwave amplifier under test to the CAL IN jack. (No input to the microwave amplifier.)
- c. Adjust the IF GAIN control to obtain an output meter pointer deflection of 30 on the DB ABOVE 1 UV scale.
- d. Connect r-f cable assembly W1205 to the input of the microwave amplifier under test.
- e. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 33 on the DB ABOVE 1 UV scale.
- f. Note the -DBM MICROVOLTS dial indication on the -dbm scale. This is the overall sensitivity of the microwave amplifier under test and the FIM-2 at the frequency of interest.
- g. To determine the overall noise figure of the microwave amplifier under test and the FIM-2, substitute the sensitivity determined in steps f, above into the following formula

$F_0 = 109.24$ - sensitivity of amplifier and FIM-2 (in -dbm)
 where F_0 = the noise figure of the microwave amplifier and FIM-2, in db.
 2-39. The noise figure of the microwave amplifier under test may now be evaluated from the following equation

$$F_A = 10 \log_{10} \left[F_0 - \frac{F_R - 1}{G} \right]$$

where F_A = the noise figure of the microwave amplifier, in db,

F_0 = the noise figure of the microwave amplifier and FIM-2, expressed as a power ratio,

F_R = the noise figure of the FIM-2, expressed as a power ratio,

G = the numeric power gain of the amplifier.

2-40. SHIELDING EFFICIENCY OF SCREEN ROOMS - HIGH ATTENUATION.

2-41. To determine the shielding efficiency of a screen room, proceed as outlined in the following steps.

a. Locate the FIM-2 and the appropriate calibrated antenna in the center of the screen room under test.

b. Locate a signal source and a transmitting antenna outside the screen room.

c. Orient the antennas (with the screen room door open) and tune the FIM-2 to the frequency of the signal source.

d. Determine the level of the signal intercepted by the calibrated antenna (see paragraph 2-12).

e. Close and lock the screen room door and again determine the level of the signal intercepted by the calibrated antenna.

f. The shielding attenuation, in db, is equal to the difference between the reading obtained in steps d and e, above.

2-42. RELATIVE POWER OF THE HARMONICS OF SIGNALS.

2-43. To determine the difference in power levels between a fundamental and its harmonics, first determine the power level of the fundamental (see paragraph 2-12). Then tune the FIM-2, in turn, to each of the harmonics of interest and determine their power levels. The difference in power levels can then be directly evaluated.

2-44. A-M ANALYSIS.

2-45. If the modulation frequency of the signal being analyzed falls within the audio range, it can be monitored by a 600-ohm headset connected to the AUDIO OUT jack, as shown in figure 2-17. To observe the a-m envelope, connect an oscilloscope having a 2-megohm input impedance to the VIDEO OUT jack, as shown in figure 2-17. To determine the percent modulation, proceed as outlined in the following steps.

a. Evaluate the level of the signal with the OUTPUT switch set to AVERAGE(E_{av}). See paragraph 2-12.

b. Evaluate the level of the signal with the OUTPUT switch set to PEAK (E_{peak}). See paragraph 2-18.

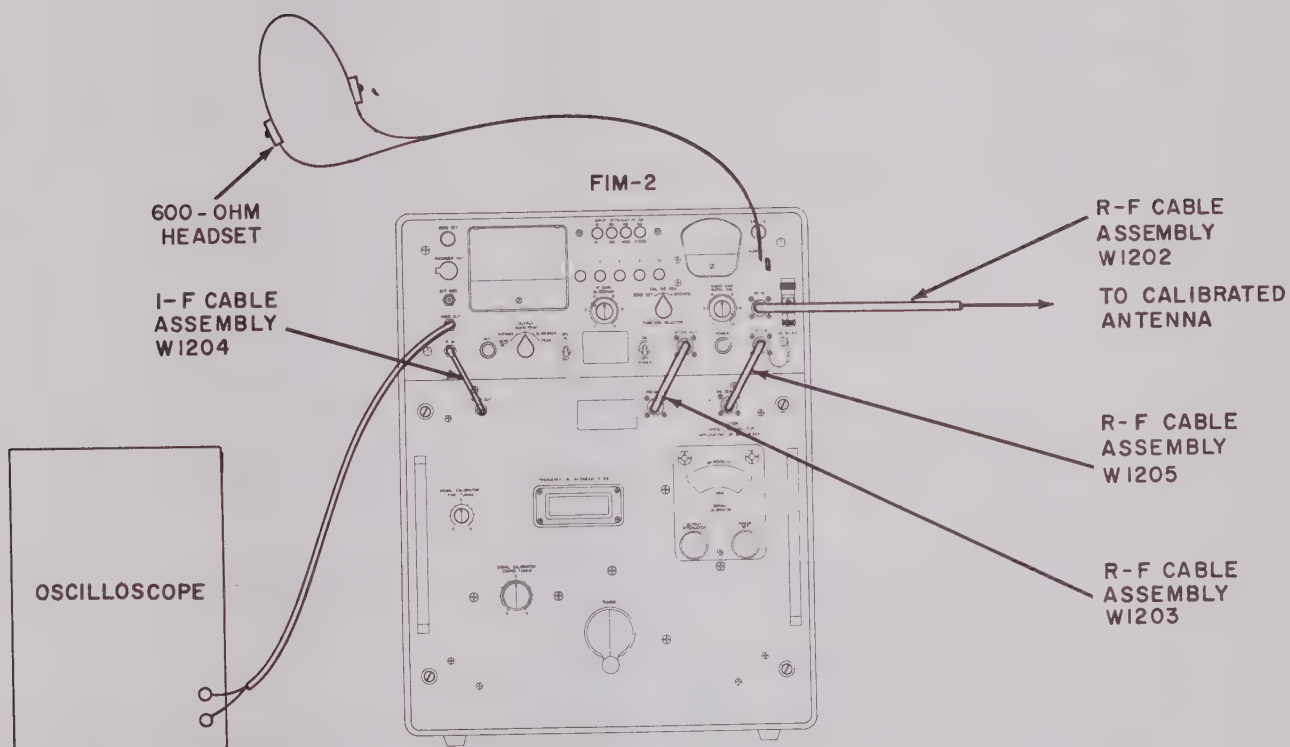


Figure 2-17. A-m Analysis, Equipment Set Up

c. The percent modulation can then be determined using the formula

$$\% \text{ Modulation} = \frac{E_{\text{peak}} - E_{\text{av}}}{E_{\text{av}}} \times 100$$

2-46. MICROWAVE PROPAGATION STUDIES.

2-47. Choose a point of relatively high intensity as a central location. Proceed radially outward, at fixed intervals, and record the output meter indications (see paragraph 2-12). Calculate the field intensity by the formula

$$E = \frac{4\pi}{\lambda} \sqrt{\frac{30P}{G}}$$

where E = the field intensity, in volts per meter,

P = the microwave power input to the FIM-2, in watts

G = the gain of the calibrated antenna, expressed as a power ratio, and

λ = the wavelength of the signal under measurement, in meters.

2-48. ANTENNA PATTERN MEASUREMENTS.

2-49. DIRECT RECEIVER METHOD. To make antenna pattern measurements by the direct receiver method, proceed as outlined in paragraph 2-22, steps a through y. Then proceed as outlined in the following steps.

a. Connect the antenna under test to the CAL IN jack, as shown in figure 2-18.

b. Connect a transmitting antenna to the SIG GEN OUT jack, as shown in figure 2-18.

c. Set the FUNCTION SEL switch to the CAL SIG GEN position.

d. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control

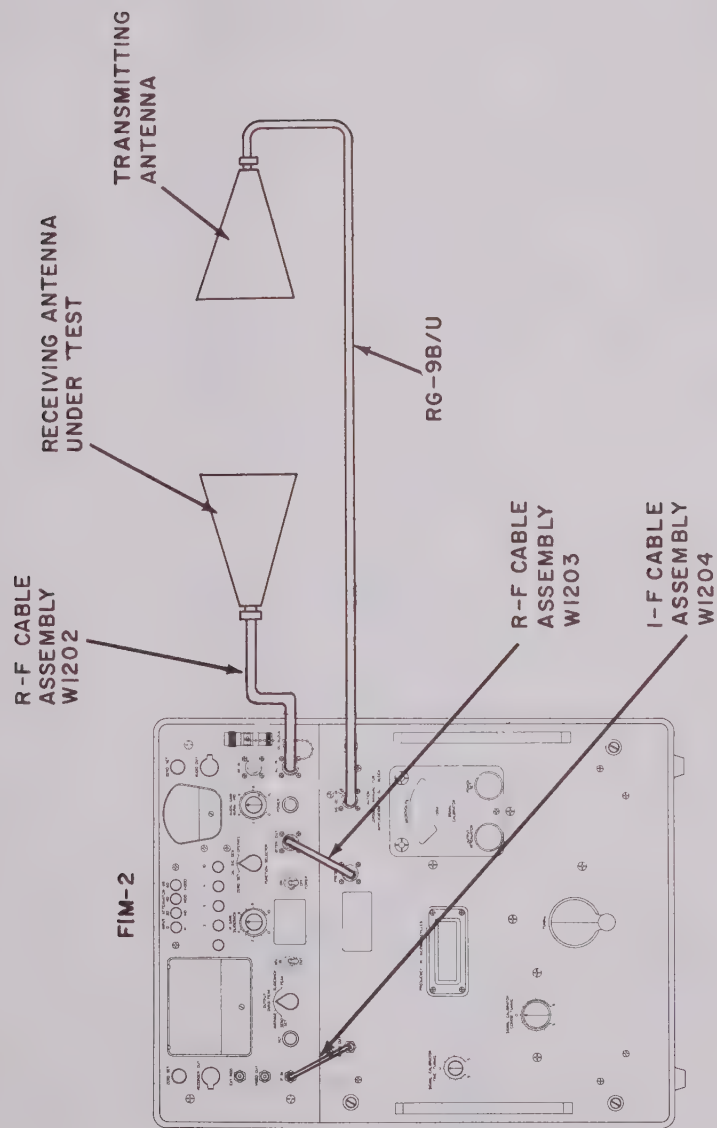


Figure 2-18. Antenna Pattern Measurements by the Direct Receiver Method, Equipment Set Up

to obtain a reference deflection of the output meter pointer at approximately 40 on the DB ABOVE 1 UV scale.

e. Rotate the antenna under test to peak the deflection of the output meter pointer.

f. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 60 on the DB ABOVE 1 UV scale.

g. Rotate the antenna under test and record, on polar coordinate paper, the output meter pointer deflection as a function of degrees of antenna rotation.

2-51. AUTOMATIC PATTERN RECORDER METHOD. To make antenna pattern measurements by the automatic pattern recorder method, proceed as outlined in paragraph 2-22, steps a through y. Then proceed as outlined in the following steps.

a. Connect the antenna under test to the CAL IN jack, as shown in figure 2-19.

b. Connect the transmitting antenna to the SIG GEN OUT jack, as shown in figure 2-19.

c. Set the FUNCTION SEL switch to the CAL SIG GEN position.

d. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of approximately 40 on the DB ABOVE 1 UV scale.

e. Rotate the antenna under test to peak the deflection of the output meter pointer.

f. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 60 on the DB ABOVE 1 UV scale.

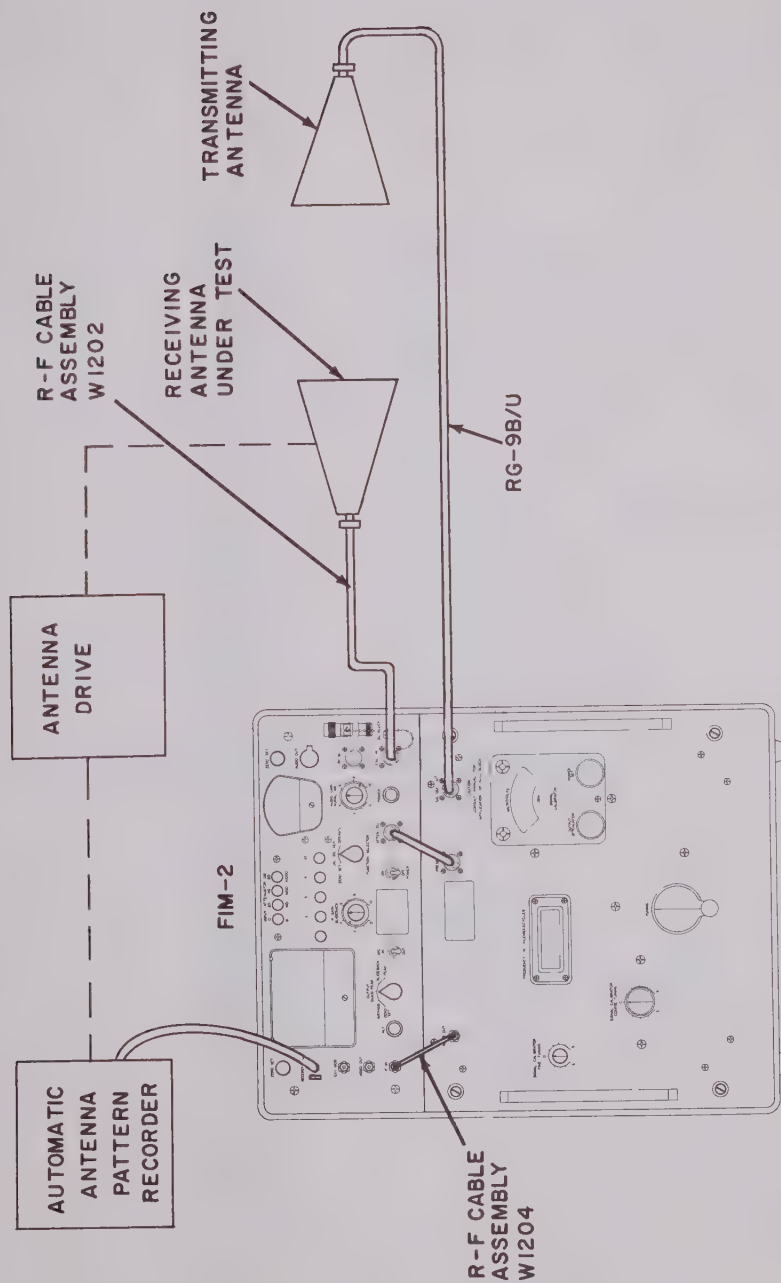


Figure 2-19. Antenna Pattern Measurements Using an Automatic Pattern Recorder, Equipment Set Up

g. Connect the automatic pattern recorder to the RECORDER OUT jack, as shown in figure 2-19.

h. Since the automatic pattern recorder drives both the polar coordinate chart and the antenna under test synchronously, the resulting curve will be that of output meter pointer deflection versus antenna rotation.

2-52. TEST PROCEDURES TO MILITARY SPECIFICATIONS.

2-53. INTRODUCTION. As an aid to the equipment manufacturer who is concerned with making interference and/or susceptibility measurements to meet government specifications, the following paragraphs describe the procedures required to perform the necessary tests. These procedures were written in compliance with the following military specifications:

- a. MIL-I-26600(USAF): Interference Control Requirements, Aeronautical Equipment (Dated 9 May 1960).
- b. MIL-I-6181D: Interference Control Requirements, Aircraft Equipment (Dated 10 May 1960).

The differences that exist between these specifications, as well as two commercial specifications, are itemized in table 2-6.

2-54. CLASSIFICATION OF EQUIPMENT. The testing of electronic equipment within the frequency range from 1,000 to 10,000 mc has been subdivided into several broad classifications by the above military specification. These classifications are defined as follows:

- a. MIL-I-26600 (USAF).

(1) Class I Equipment.

"Class I equipment is electrical or electronic equipment including special purpose test equipment installed in or closely associated with airborne weapons systems. This class shall be subdivided into two subclasses, defined as follows:"

TABLE 2-6. COMPARISON OF INTERFERENCE SPECIFICATIONS.

MEASUREMENT	SPECIFICATION AND LIMITS			
	MIL-I-26600 (USAF) AMENDMENT 2	MIL-I-6181D	WDD-M-PRO-2	HCD-487
AMBIENT INTERFERENCE LEVEL.....	At least 6 db below allowable specified inter- ference level	At least 6 db below allowable specified inter- ference level	At least 6 db below allowable specified inter- ference level	At least 6 db below allowable specified inter- ference level
RADIATED INTERFERENCE				
Narrowband (cw).....	30 db above 1 uv ¹ (class Ib, II and III)	60 db above 1 uv per meter ¹	30 db above 1 uv	40 db above 1 uv
Broadband and pulsed cw.....	15 db above 1 uv per megacycle ² (class Ib, II and III)	80 db above 1 uv per megacycle per meter ²	15 db above 1 uv per megacycle	Not required
ANTENNA CONDUCTED SPUR- IOUS EMANATIONS				
TRANSMITTER KEYUP OR RECEIVER ³ :				
Narrowband (cw).....	40 db above 1 uv ¹ (class Ib and III)	40 db above 1 uv ¹	40 db above 1 uv	200 uwatts
Broadband.....	60 db above 1 uv per megacycle ² (class Ib and III)	60 db above 1 uv per megacycle ²	60 db above 1 uv per megacycle	200 uwatts
TRANSMITTER KEYDOWN...	Power (in db be- low fundamental power) = 80 + 10 log P, where P is the fundamen- tal power in watts (class Ib and III)	The peak power of second and third harmonics shall be at least 60 db below that of the fundamental, or 10-8 watts (707 microvolts into 50 ohms), which- ever is greater	Power (in db be- low fundamental power) = 80 + 10 log P, where P is the fundamen- tal power in watts	60 db below rated output
SUSCEPTIBILITY				
Radio frequency conducted.....	100,000 uv from a source having an impedance of 50 ohms (class Ib and III)	100,000 uv from a source having an impedance of 50 ohms (class Ib and III)	100,000 uv from a source having an impedance of 50 ohms (class Ib and III)	100,000 uv
Radio frequency radiated.....	100,000 uv with a nondirective an- tenna (class Ib and III)	100,000 uv from a 50-ohm source driving the cal- ibrated antennas	100,000 uv from a 50-ohm source	100,000 uv
RECEIVER FRONT END REJECTION.....	60 db within tun- ing range; 80 db outside tuning range (class Ib and III)	60 db within tun- ing range; 80 db outside tuning range	60 db within tun- ing range; 80 db outside tuning range	60 db minimum

¹ FIM-2 in AVERAGE position.² FIM-2 in PEAK position.³ Not required providing contractor can furnish satisfactory evidence to the procuring activity that such measurements do not result in any significant data.

(a) Class Ia Equipment.

"This subclass applies to equipment and subsystems intended for installation in manned aircraft that do not carry missiles as operational combat armament. The interference control requirement for this class shall be in accordance with MIL-I-6181."

(b) Class Ib Equipment.

"Class Ib equipment shall be all class I equipment **** other than that included in class Ia ****. Requirements and tests for class Ib shall be in accordance with *****. Class Ib specifically includes the following equipments:

- a. Ground support equipment.
- b. Air vehicles carrying missiles as operational combat armament.
- c. All missiles."

(2) Class II Equipment.

"Class II equipment is the individual electrical and electronic equipment which is used with a surface system. Included are:

- a. Electronic equipment such as receivers ***** and associated power supplies and subassemblies.
- b. Electrical equipment used in conjunction with electronic equipment such as heaters *** et cetera.
- c. Electrical power equipment such as generators *** used to furnish power to electronic equipment."

b. MIL-I-6181D.

"For Air Force use, the requirements of MIL-I-6181D shall apply only to equipment and subsystems intended for installation in manned aircraft that do not carry missiles as operational armament."

"The requirements of MIL-I-26600 shall apply in all other cases and specifically to the following classes of equipment:

- a. Ground support equipment.
- b. Air vehicles carrying missiles as operational combat armament.
- c. All classes of missiles."

2-55. RADIATED INTERFERENCE MEASUREMENTS. When making radiated interference measurements, choose a suitable location for the conduction of the test. An anechoic chamber (or other shielded enclosure free from reflections) is preferable. Broadband absorbing materials, such as loosely-spun mats, are available for lining the interior of a screen room to provide an area which is free from extraneous signals. By these methods power reflections may be reduced to less than two percent. If a microwave test chamber is not conveniently available, the measurements may be made in any suitable location, provided that the ambient interference level is at least 6 db below the allowable specified interference level.

2-56. The procedure for broadband radiated interference measurements is outlined in paragraph 2-17; that for narrowband radiated interference measurements in paragraph 2-12. The test set ups for these measurements are shown in figures 2-20, 2-21, 2-22, and 2-24.

2-57. ANTENNA CONDUCTED SPURIOUS EMANATIONS. When making antenna conducted spurious emanation measurements, the procedure outlined in paragraph 2-12 (narrowband) and 2-17 (broadband) are employed. The test set ups for these measurements are shown in figures 2-20, 2-21, 2-22, and 2-23.

2-58. CONDUCTED SUSCEPTIBILITY MEASUREMENTS. When making conducted susceptibility measurements, adjust the FIM-2 for an output of 100,000 microvolts (signal generator operation). Connect the component under test to the SIG GEN OUT jack via r-f cable assembly W1202 and d-c blocking capacitor C1201, as shown in figure 2-24.

CAUTION:

WHEN MAKING CONDUCTED SUSCEPTIBILITY TESTS, BE SURE TO CONNECT D-C BLOCKING CAPACITOR C1201 BETWEEN THE SIG GEN OUT JACK AND THE LINE STABILIZATION NETWORK, AS SHOWN IN FIGURE 2-24. FAILURE TO DO SO MAY RESULT IN DAMAGE TO THE SIGNAL CALIBRATOR OUTPUT ATTENUATOR PROBE.

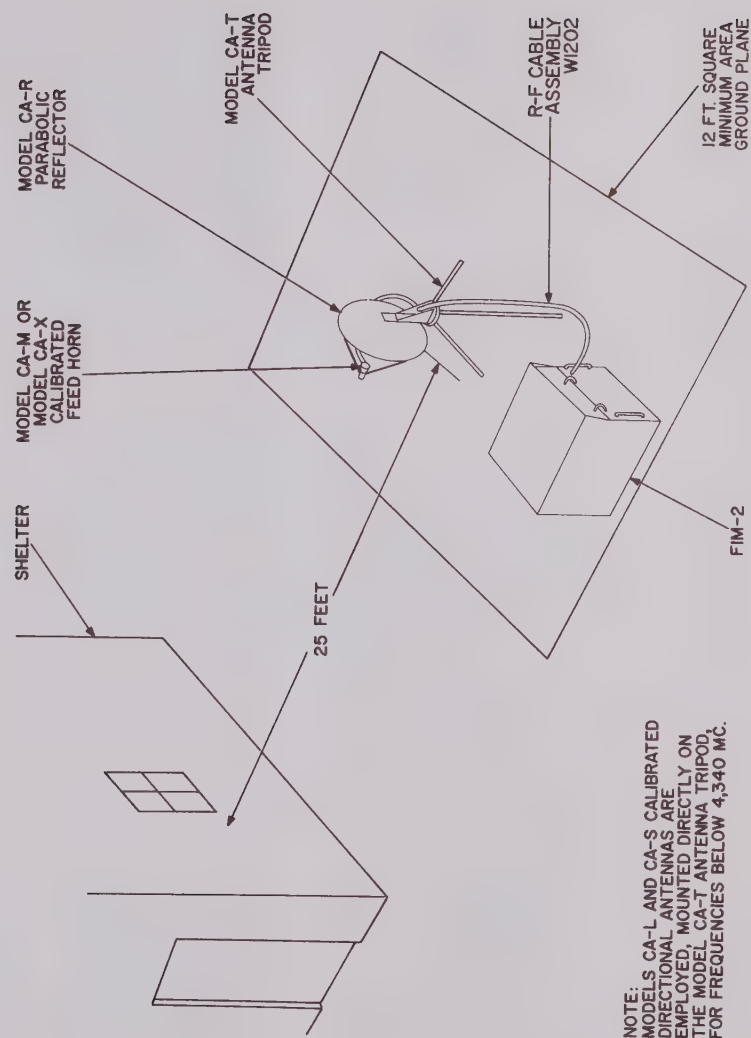


Figure 2-21. Radiated Interference Measurements, Typical Test Set Up (MIL-I-26600, Class II Equipment)

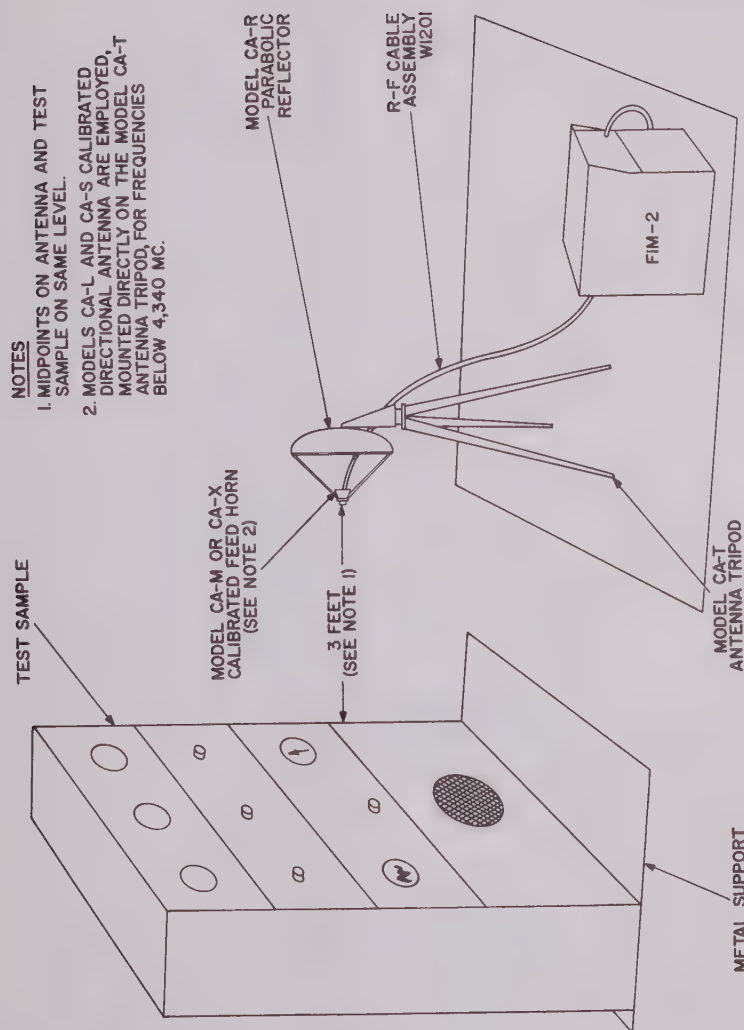


Figure 2-22. Radiated Interference Measurements, Typical Test Set Up (MIL-I-26600, Class III Equipment)

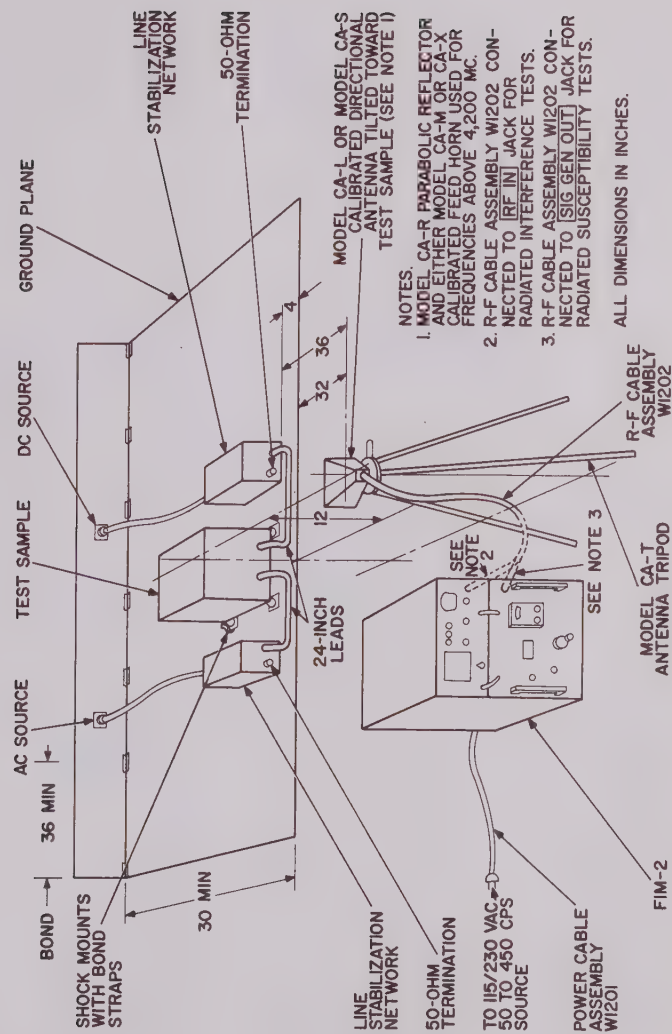


Figure 2-23. Radiated Interference and Susceptibility Measurements, Typical Test Set Up (MIL-I-6181D)

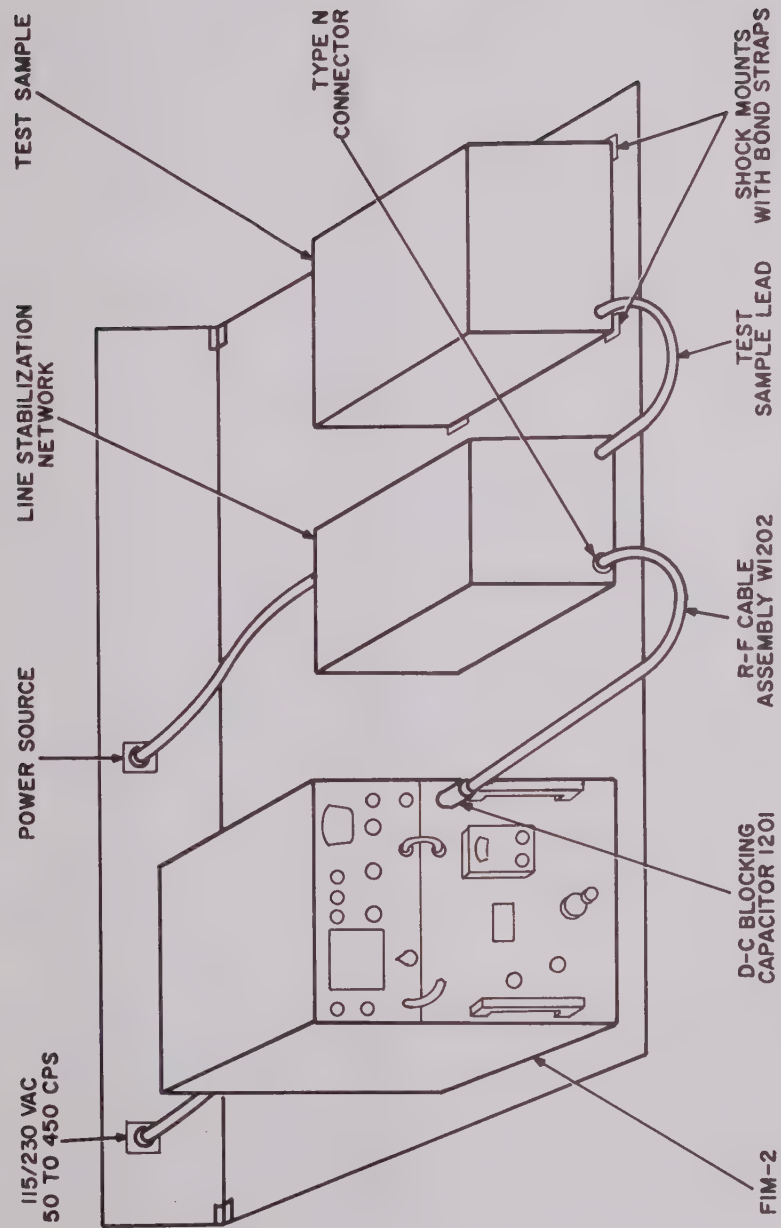


Figure 2-24. Conducted Susceptibility, Typical Test Set Up
MIL-I-6181D and MIL-I-26600)

2-59. The test for conducted susceptibility shall be considered successful if the application of the 100,000 microvolt signal produces no change in indication, malfunction, or degradation of performance of the test sample.

2-60. RADIATED SUSCEPTIBILITY MEASUREMENTS. When making radiated susceptibility measurements, adjust the FIM-2 for an output of 100,000 microvolts (signal generator operation). Connect the appropriate calibrated antenna to the SIG GEN OUT jack, as shown in figure 2-20 (MIL-I-26600) or figure 2-23 (MIL-I-6181D). The test for radiated susceptibility shall be considered successful if the component under test shows no change in indication, malfunction, or degradation of performance.

2-61. RECEIVER FRONT END REJECTION. When making receiver front end rejection measurements, tune the receiver under test to any frequency within its tuning range. Determine the level of the minimum perceptible signal at that frequency. Then scan the band of the receiver with the FIM-2 set to an output 60 db above the minimum perceptible signal (signal generator operation). The test shall be considered successful if the receiver rejection is at least 60 db.

2-62. Repeat the above paragraph with the FIM-2 set to an output 80 db above the minimum perceptible signal level at frequencies outside the tuning range of the receiver under test. The test shall be successful if the receiver rejection is at least 80 db.

2-63. AUXILIARY EQUIPMENT.

2-64. When the FIM-2 is used in conjunction with the Polarad Model TSA-S Combination Synchroscope-Spectrum Analyzer (which dis-

plays r-f energy as a function of both time and frequency), these two instruments provide complete facilities for the analysis of any interference signal in terms of absolute power, rise time, decay time, pulse width, pulse repetition rate, relative amplitude of main and side lobes, type of modulation, symmetry of spectrum, and many other characteristics. Remedial measures are greatly facilitated by such a thorough analysis of the interference signal. Typical synchroscope-spectrum analyzer signals, both as functions of time and frequency, are shown in figure 2-25.

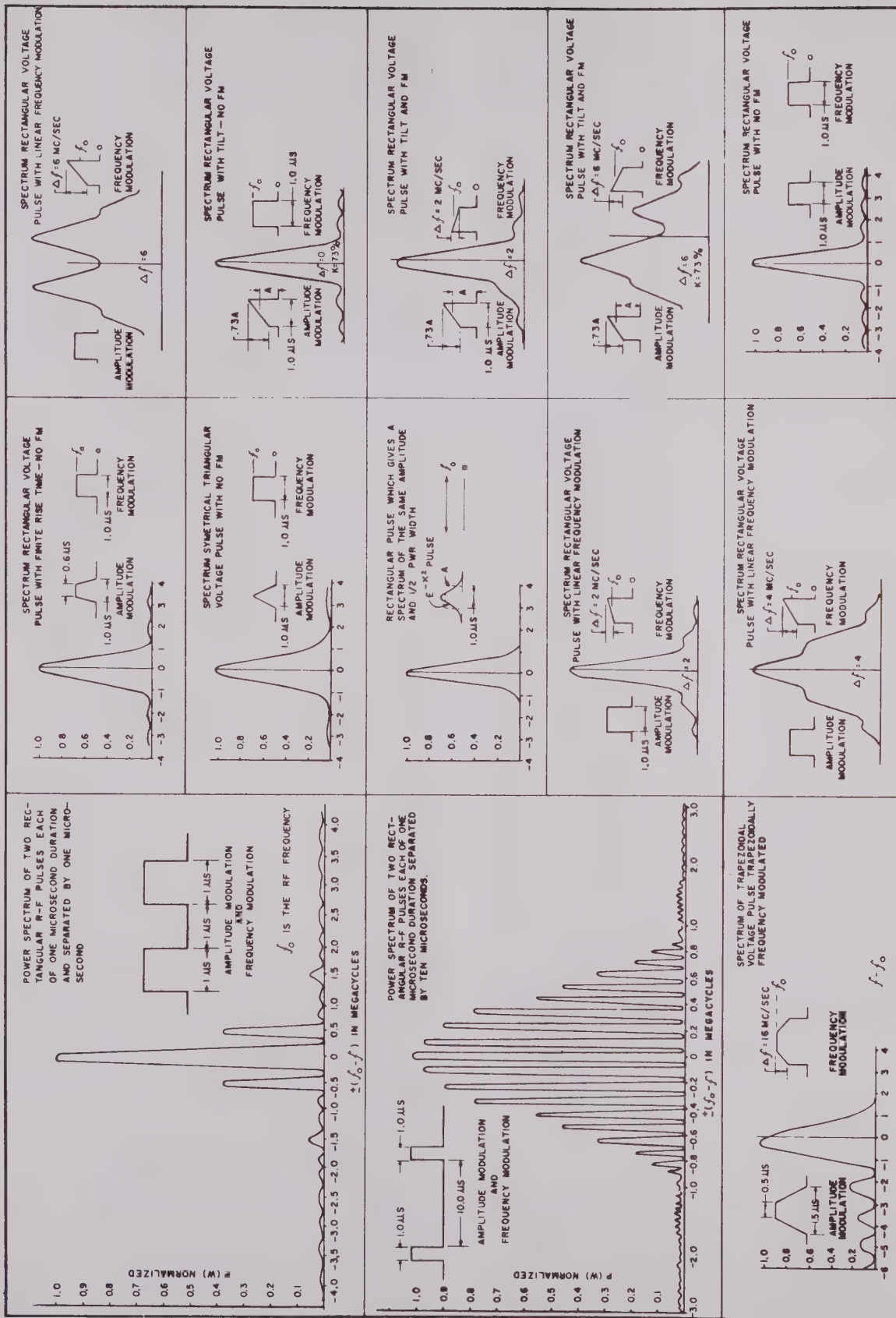


Figure 2-25. Typical Synchroscope-Spectrum Analyzer Displays

SECTION III
THEORY OF OPERATION

3-1. GENERAL.

3-2. The Model FIM-2 Field Intensity Meter is a sensitive and frequency selective triple conversion superheterodyne microwave receiver and calibrated microwave signal generator which covers the frequency range from 1,000 to 10,000 mc in four overlapping bands. It is used as a sensitive r-f voltmeter (power meter) to determine the absolute level of r-f signals. In addition to the usual microwave receiver circuitry, the FIM-2 contains the following:

a. A signal calibrator, physically contained within each Tuning Unit, for both calibrating the gain of the receiver section and for use as a calibrated microwave signal generator.

b. An r-f preselector, also physically contained within each Tuning Unit, and a high-frequency first i-f to ensure adequate image and spurious response rejection.

c. Calibrated attenuators (r-f: 0 to 60 db in 20-db steps, i-f: 0 to 20 db in 1-db steps) to extend the basic 20 to 1,000 microvolt input signal range to a maximum of three volts rms.

d. Automatic frequency control (afc) to compensate for incoming signal frequency drift.

e. Automatic gain control (agc) to provide an adequate dynamic range.

f. A calibrated output voltmeter having three scales (r-f microvolts, decibels above one microvolt, and decibels above one microvolt per megacycle).

g. Weighting circuits for the measurement of the average, quasi-peak, slideback-peak, or peak values of incoming r-f signals.

h. Audio, video, and recorder outputs.

i. An aural aid to facilitate the detection of unmodulated r-f signals.

3-3. NOT USED.

3-4. BLOCK DIAGRAM ANALYSIS, MICROWAVE RECEIVER OPERATION.

3-5. The incoming r-f signal under measurement is coupled to the RF IN jack and applied to the input of a coaxial r-f transfer switch, as shown in figure 3-1. When the FUNCTION SEL switch is in the OPERATE position, the signal is passed through the transfer switch and applied to the calibrated coaxial attenuators, which insert between 0 and 60 db of r-f attenuation in the incoming signal path (in 20-db steps, as determined by the r-f INPUT ATTENUATOR DB push-button switch depressed). The output of the calibrated attenuators is then fed to the input of the preselector via a front panel jumper cable.

3-6. That portion of the r-f signal under measurement which falls within the pass-band of the preselector is coupled to the first crystal mixer. Simultaneously, r-f energy from the first local oscillator, which is tuned to a frequency 260 mc away from the preselector, is also applied to the first crystal mixer. The non-linear characteristics of the crystal produces a 260-mc difference frequency signal (the first i-f), which is coupled to the 260/140-mc preamplifier via a front panel jumper cable.

3-7. The 260/140-mc preamplifier amplifies the first i-f signal and heterodynes it with the 120-mc output of the crystal-controlled local oscillator, thus producing the second intermediate frequency

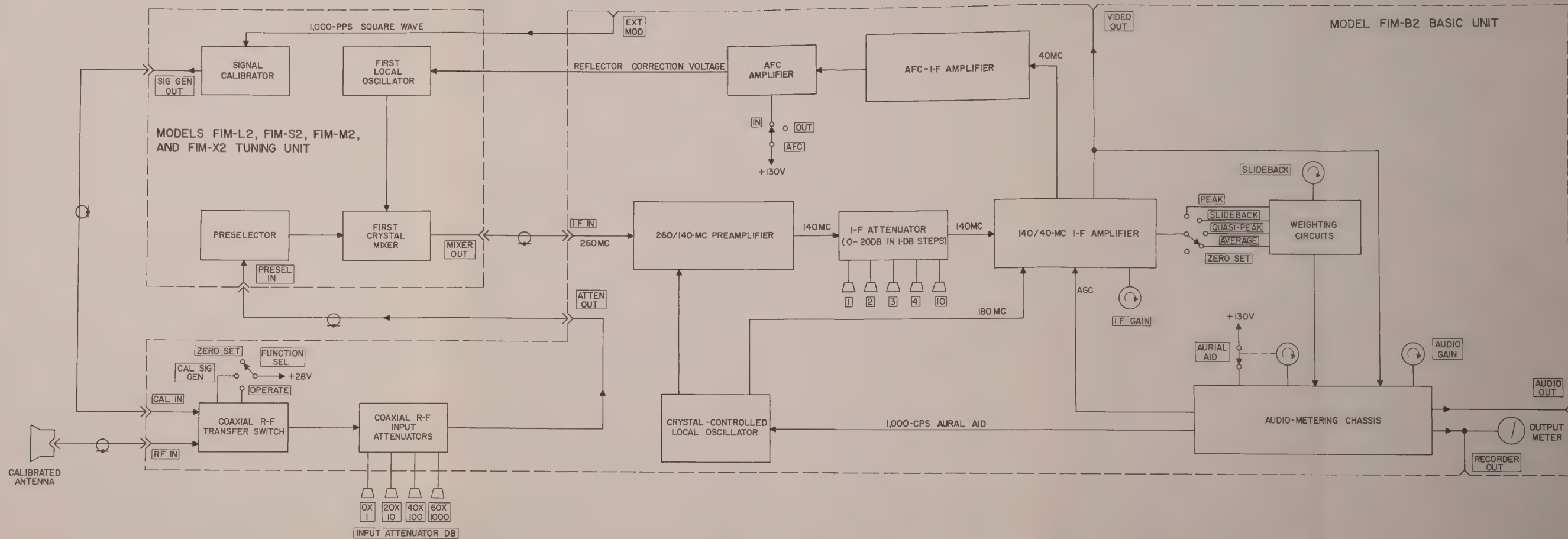


Figure 3-1. Model FIM-2 Field Intensity Meter, Simplified Block Diagram

signal centered at 140 mc.

3-8. The output of the 260/140-mc preamplifier is then applied to the 140-mc i-f attenuator, which provides i-f attenuation in 1-db steps from 0 to 20 db, as determined by the setting of the i-f Input Attenuator Db push-button switches. The output of the i-f attenuator is then fed to the 140/40-mc i-f amplifier.

3-9. The 140-mc output of the i-f attenuator is amplified and then mixed with the 180-mc output of the crystal-controlled local oscillator within the 140/40-mc i-f amplifier to produce the 40-mc third intermediate frequency signal. A portion of this signal is applied to the afc-i-f amplifier (see paragraph 3-10); the remainder is divided between two detectors, one supplying the weighting circuits (see paragraph 3-11) and the other supplying the audio amplifier portion of the audio-metering chassis (see paragraph 3-12) and the VIDEO OUT jack.

3-10. The nominally 40-mc third i-f signal applied to the afc-i-f amplifier is amplified, limited, and applied to afc discriminators. If the signal is not centered at 40 mc, a d-c error signal is generated and applied to the afc amplifier. This error signal is then amplified by the afc amplifier and, when the AFC switch is in the IN position, the amplified d-c error signal is superimposed upon the first local oscillator reflector voltage, thus causing the operating frequency of the klystron to shift in that direction which will maintain the third i-f signal at 40 mc. This "electronic tuning" keeps the FIM-2 tuned to the signal under measurement despite possible frequency drift of the incoming r-f signal.

3-11. That portion of the 40-mc third i-f signal which is detected and applied to the weighting circuit (determined by the position of the OUTPUT switch) produces an output signal proportional to the type

of measurement selected (i.e., average, quasi-peak, slideback-peak, or peak). This output signal is then applied to the audio-metering chassis where it is amplified and applied to both the output meter and the RECORDER OUT jack. The output meter provides a visual indication of the level of the r-f input signal under measurement, while the RECORDER OUT jack provides the facility for simultaneous recording of the output meter indication.

3-12. That portion of the detected 40-mc third i-f signal which is applied to the VIDEO OUT jack for external oscilloscope observation of the modulation component is also applied to the audio amplifier in the audio-metering chassis. Any audio-modulation present is amplified and coupled to the AUDIO OUT jack for monitoring through an external 600-ohm headset.

3-13. An aural tuning aid circuit is employed to facilitate the detection of unmodulated r-f signals by modulating the 120-mc output of the crystal-controlled local oscillator with a 1,000-cps audio signal. This circuit is energized when the AURAL AID control is rotated clockwise beyond its "off" position. The modulation can thus be monitored with the external headset that is connected to the AUDIO OUT jack.

3-14. BLOCK DIAGRAM ANALYSIS, MICROWAVE SIGNAL GENERATOR OPERATION.

3-15. When the FUNCTION SEL switch is set to the CAL SIG GEN position, the reflex klystron signal calibrator is energized. This signal calibrator is capable of generating either cw or 1,000-pps square-wave modulated cw signals. The amplitude of the cw signal is continuously variable between 0 and -95 dbm (0.223 volts rms to 5 microvolts), as determined by the setting of the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control, and is available at the SIG GEN OUT jack.

3-16. DETAILED THEORY OF OPERATION, TUNING UNITS.

3-17. The four Tuning Units are identical in principles of operation. Differences exist, due to the frequency range of each Tuning Unit, in the type of reflex klystron tubes, crystal mixers, and preselectors employed. In addition, to cover the Model FIM-L2 and Model FIM-X2 Tuning Unit frequency ranges with adequate output power, mode switching is employed in these Tuning Units. Table 3-1 is a convenient listing of the detailed differences that exist between the four Tuning Units. The reader should refer to the individual detailed schematic diagrams of the Tuning Units (figures 5-1 through 5-4) to note the actual circuit differences. Paragraphs 3-18 through 3-57 describe the Model FIM-X2 Tuning Unit.

3-18. PRESELECTOR.

3-19. The preselector (see figure 3-2 and 3-3) consists of two aperture-coupled cavities simultaneously tracked throughout the tuning range of the Model FIM-X2 Tuning Unit. The cavities operate as a $3/4$ -wavelength resonant line acting as a double-tuned network at the input of the Tuning Unit. In operation, the preselector is tuned to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial by a single tuning cam actuated by the TUNING control through the precision mechanical drive system. Fine adjustment of the two preselector tuning plungers, one for each cavity, is accomplished by two tape cams mounted on a rack and gear assembly above the preselector, as shown in figure 3-3. This fine tuning capability provides incremental adjustment of the individual tuning plunger positions within the cavity through the action of two L-shaped rocker arms, thus precisely tuning the preselector at all points within the frequency range of the Tuning Unit.

TABLE 3-1. TUNING UNIT DIFFERENCE DATA.

Characteristic	Tuning Unit			
	Model FIM-L2	Model FIM-S2	Model FIM-M2	Model FIM-X2
Tuning range and signal calibrator frequency range (in megacycles)	1,000 to 2,240	2,140 to 4,340	4,200 to 7,740	7,360 to 10,000
First local oscillator frequency range (in megacycles)	1,260 to 2,500 (260 mc above sig. cal.)	2,400 to 4,600 (260 mc above sig. cal.)	4,460 to 8,000 (260 mc above sig. cal.)	7,100 to 9,740 (260 mc below sig. cal.)
Signal calibrator, first local oscillator, and preselector cavity mode (in wavelength)	1/4	3/4	3/4	3/4
Signal calibrator tube type	7505/ZV1010	7049/ZV1009	8052/ZV1011	8052/ZV1011
First local oscillator tube type	7505/ZV1010	7049/ZV1009	8052/ZV1011	8052/ZV1011
Reflector mode switching	Required	Not required	Not required	Required
Signal calibrator reflector mode	a. 1-3/4 wave for frequencies below 1.3 kmc b. 2-3/4 wave for frequencies above 1.3 kmc	2-3/4 wave throughout the entire tuning range	2-3/4 wave throughout the entire tuning range	a. 3-3/4 wave for frequencies below 9.1 kmc b. 4-3/4 wave for frequencies above 9.1 kmc
First local oscillator reflector mode	a. 1-3/4 wave for frequencies below 1.56 kmc b. 2-3/4 wave for frequencies above 1.56 kmc	2-3/4 wave throughout the entire tuning range	2-3/4 wave throughout the entire tuning range	a. 3-3/4 wave for frequencies below 8.84 kmc b. 4-3/4 wave for frequencies above 8.84 kmc
Anode voltage	-325 volts	-325 volts	-1,000 volts	-1,250 volts
Control grid voltage*	+8 to +10 v	+8 to +10 v	+8 to +10 v	+8 to +10 v
Anode current	28ma	28 ma	20 ma	20 ma

* With respect to anode voltage.

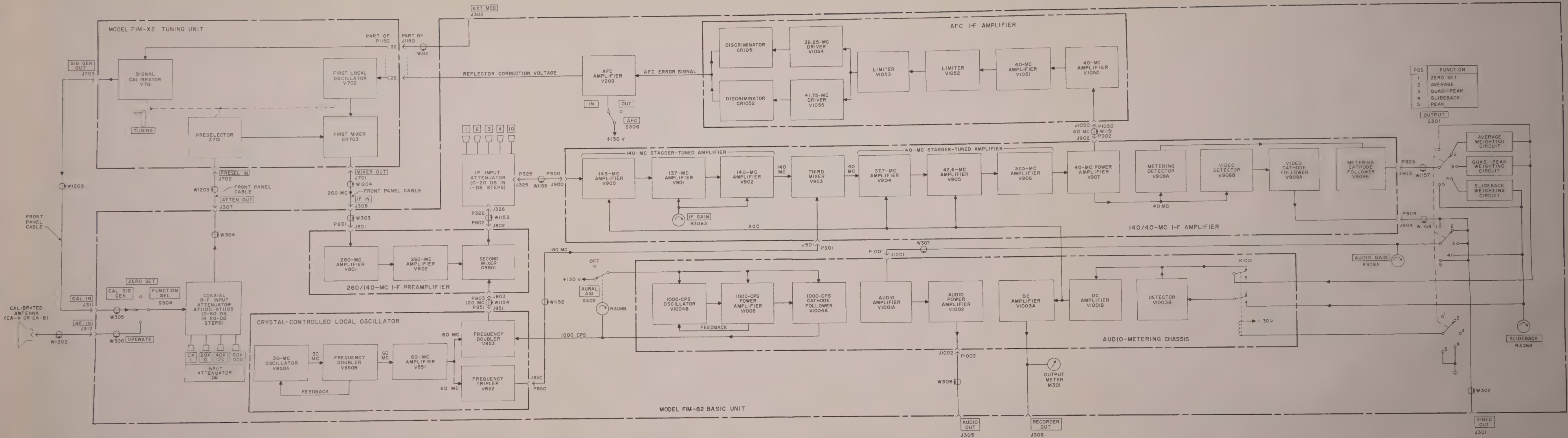


Figure 3-2. Model FIM-2 Field Intensity Meter, Detailed Block Diagram

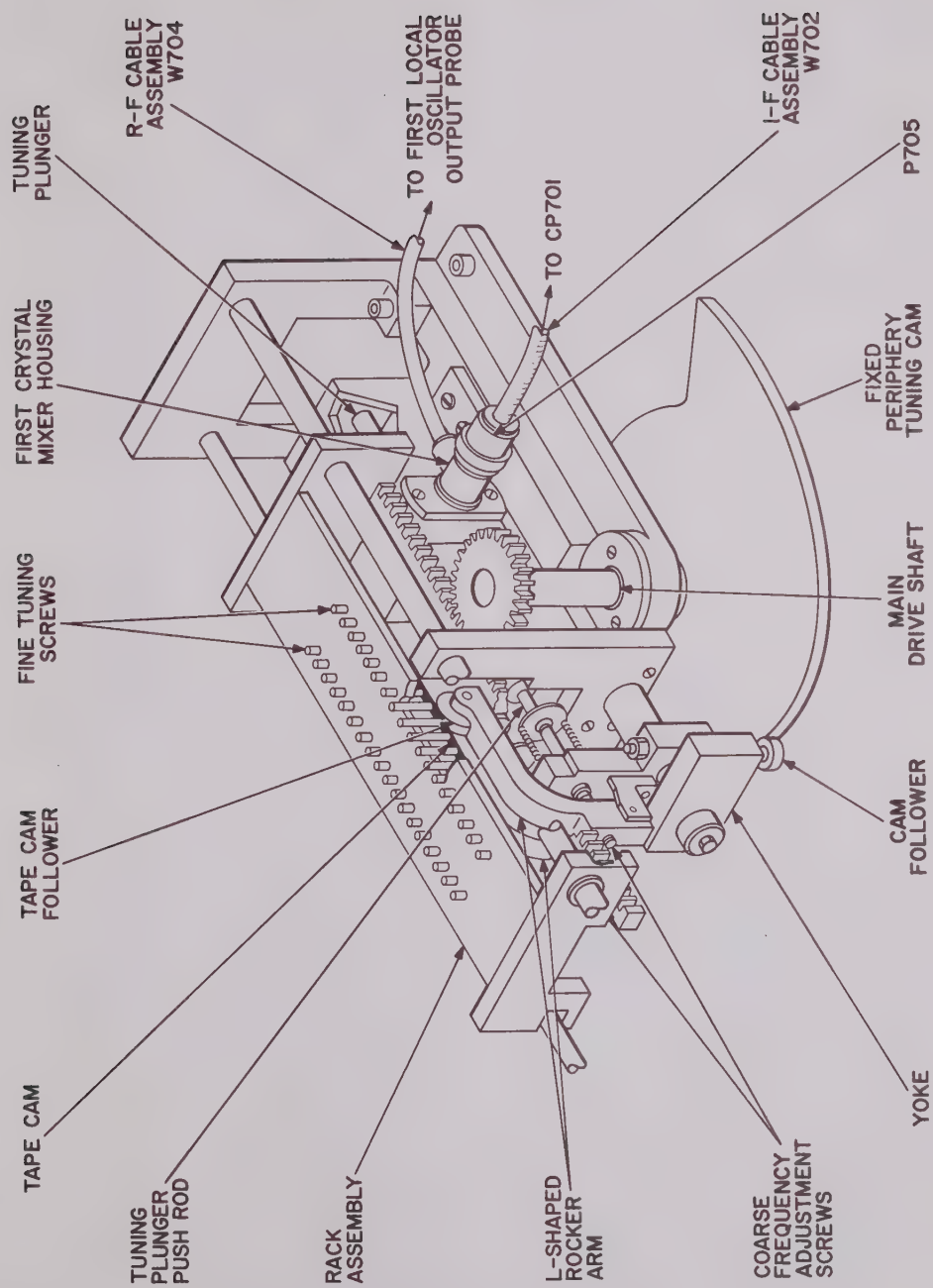


Figure 3-3. Model FIM-X2 Tuning Unit Preselector

3-20. In the Model FIM-L2 and Model FIM-S2 Tuning Units, a series of adjusting screws located at the top of the preselector (see figure 3-4) provide the facility for fine tuning of the preselector cavity. These screws are adjusted for each cavity to vary the capacitance between the preselector tuning plunger and the cavity wall.

3-21. FIRST LOCAL OSCILLATOR V702.

3-22. First local oscillator V702 is a reflex klystron tube operating in an external resonant cavity, as shown in figure 3-5. The cavity is in the form of a coaxial transmission line, and consists of two cylinders - one inside the other. The reflex klystron tube is inserted at one end of the cavity so that the outer cylinder makes contact with the first interaction grid (so termed because it is closer to the cathode). The spring fingers of the inner cylinder make contact with the second interaction grid. The circuit is completed at the other end of the cavity by a movable non-contacting shorting plunger of special construction. The position of this movable short determines the physical wavelength, and hence the operating frequency, of the cavity. The first local oscillator reflector voltage, which determines the exact electrical frequency of operation of the reflex klystron, is tracked with the movement of the shorting plunger by the precision mechanical drive system (see paragraph 3-53). Power is extracted from the cavity by loop coupling at a fixed point within the cavity.

3-23. FIRST LOCAL OSCILLATOR REFLECTOR VOLTAGE TRACKING CIRCUIT.

3-24. The frequency of operation of the first local oscillator is determined by both the physical wavelength of the external resonant cavity and the magnitude of the reflector (reflector to cathode)

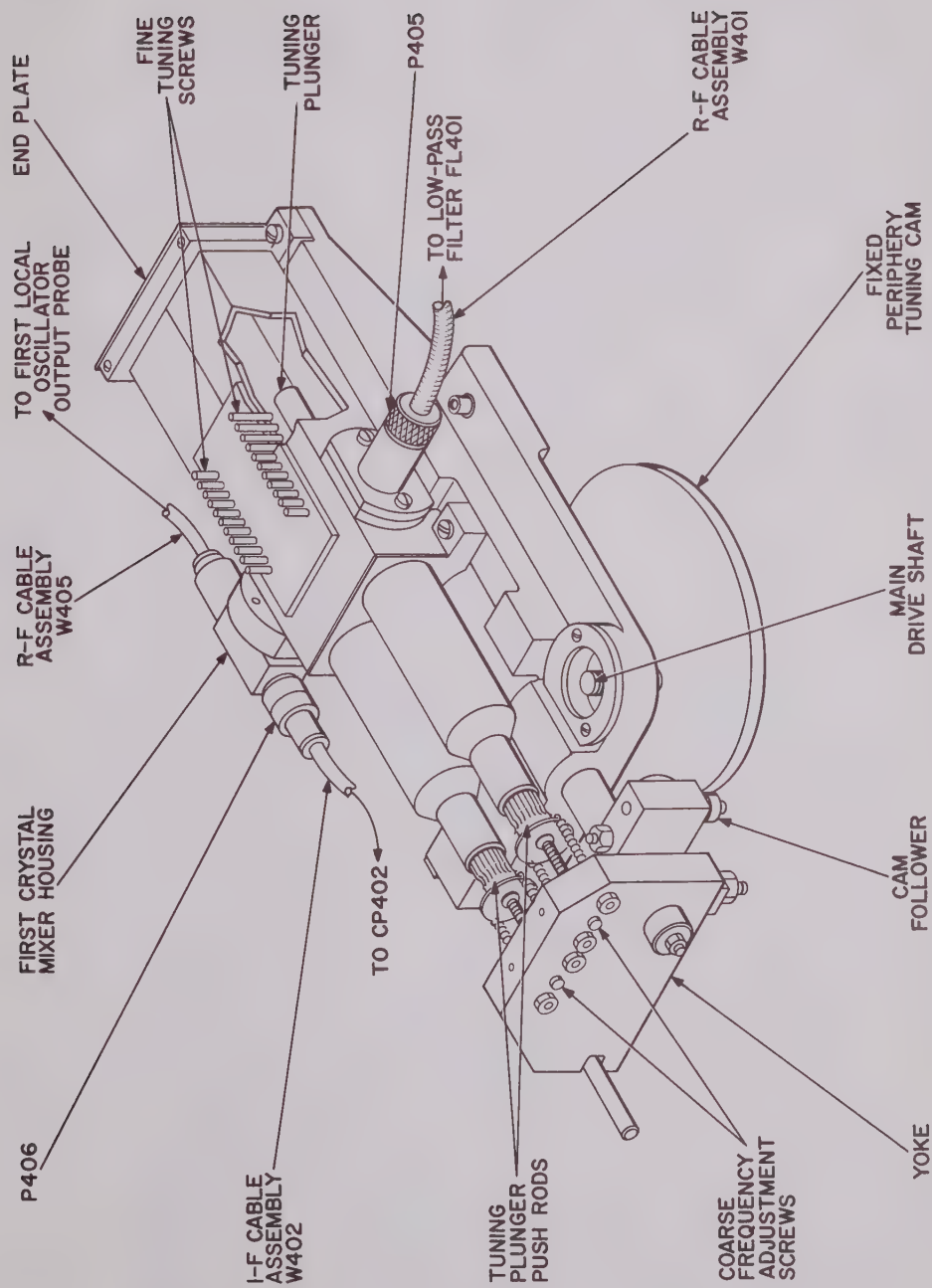


Figure 3-4. Model FIM-L2 Tuning Unit Preselector

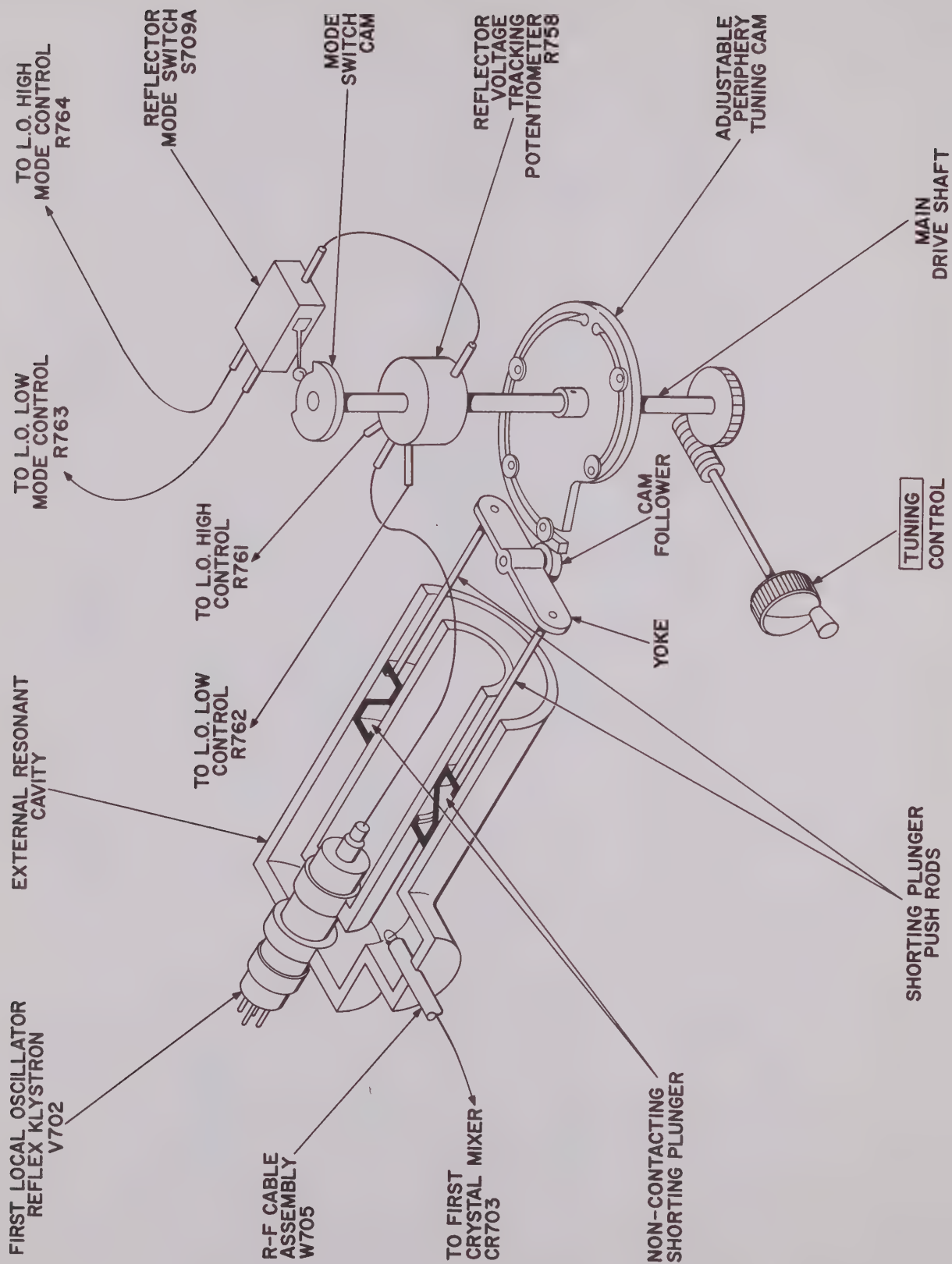


Figure 3-5. First Local Oscillator V702, Simplified Electromechanical Diagram

voltage. The d-c voltage applied to the reflector is controlled by wire-wound potentiometer R758. The wiper arm of this control is mechanically ganged to the movable non-contacting shorting plunger located in the first local oscillator external resonant cavity.

3-25. For a given setting of the resonant cavity, there is an optimum reflector voltage required for oscillation. The reflector voltage, therefore, must vary as the operating frequency of the first local oscillator is to be changed. As the frequency increases, the magnitude of the reflector voltage also increases (and vice versa) to maintain the maximum amplitude of oscillation. In the vicinity of 8,900 mc, the reflector voltage becomes excessively high and the power output of the reflex klystron drops. At this point it becomes advantageous to switch to the next higher reflector mode of operation.

3-26. This is accomplished by mode switch S709A without changing the frequency of operation of the first local oscillator. The reflector voltage is reduced so that the first local oscillator reflex klystron operates in the $4\text{-}3/4$ -wave reflector mode instead of the $3\text{-}3/4$ -wave mode. The $4\text{-}3/4$ -wave reflector mode is maintained throughout the remainder of the tuning range. Reflector mode switch S709A is activated by a teflon cam mounted on the control shaft of reflector voltage tracking potentiometer R758.

3-27. The resistors in the reflector voltage tracking circuit (R757 and R771) are selected to insure that the proper frequency-versus-voltage characteristics are obtained for the reflector electrode (see figure 3-6). Potentiometers R761, R762, R763, and R764, which are screwdriver adjusted, set the minimum and maximum voltages that can be applied to the reflector voltage tracking potentiometers.

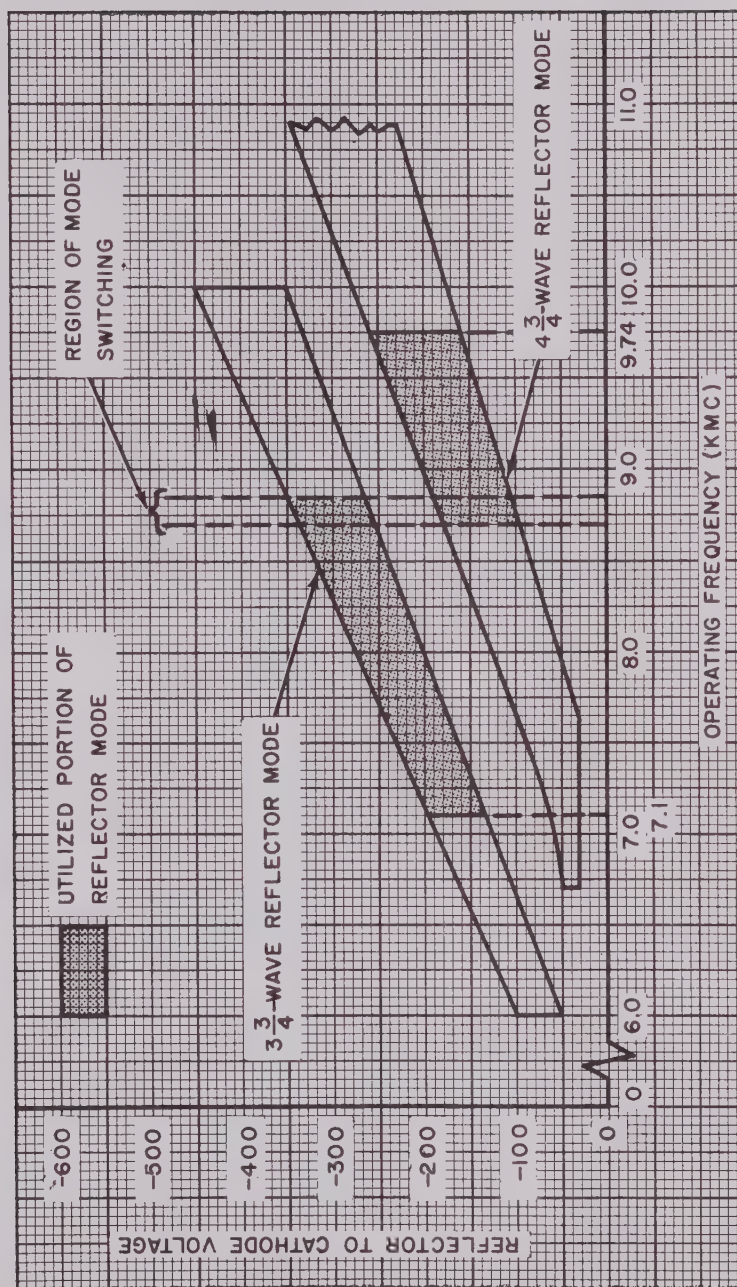


Figure 3-6. First Local Oscillator Frequency Versus Reflector Voltage Characteristic Curve

3-28. FIRST CRYSTAL MIXER CR703.

3-29. The r-f signal falling within the pass-band of the preselector and the r-f output of first local oscillator V702 are simultaneously applied to first crystal mixer CR703. Since the difference between these two signals is always 260 mc (see table 3-1), the non-linear characteristics of the crystal will produce the sum and difference frequencies of these two signals. The output of first crystal mixer CR703 is then coupled to the input of the 260/140-mc preamplifier (see paragraph 3-65) via MIXER OUT jack J701, i-f cable assembly W1204, and IF IN jack J308.

3-30. SIGNAL CALIBRATOR V701.

3-31. Signal calibrator V701 is a reflex klystron tube operating in an external resonant cavity in the same fashion as first local oscillator V702 (see paragraph 3-21). Unlike the first local oscillator, the signal calibrator is capable of supplying a calibrated r-f output signal which is adjustable over the range from 0.223 volts rms to 5 microvolts (0 to -95 dbm). This capability enables the FIM-2 to serve as a calibrated microwave signal generator, obviating the need for an external signal generator to calibrate the gain of the receiver portion of the system.

3-32. Signal calibrator V701 operates only when the FUNCTION SEL switch is set to the CAL SIG GEN position. For the other two positions of FUNCTION SEL switch S304, namely ZERO SET and OPERATE, the control grid of V701 is biased beyond cutoff, preventing the klystron from oscillating. When in operation, r-f energy is extracted from the external resonant cavity at two points: within the output attenuator waveguide-below-cutoff pipe and within the power set waveguide-beyond-cutoff pipe (see figure 3-7 and paragraph 3-36).

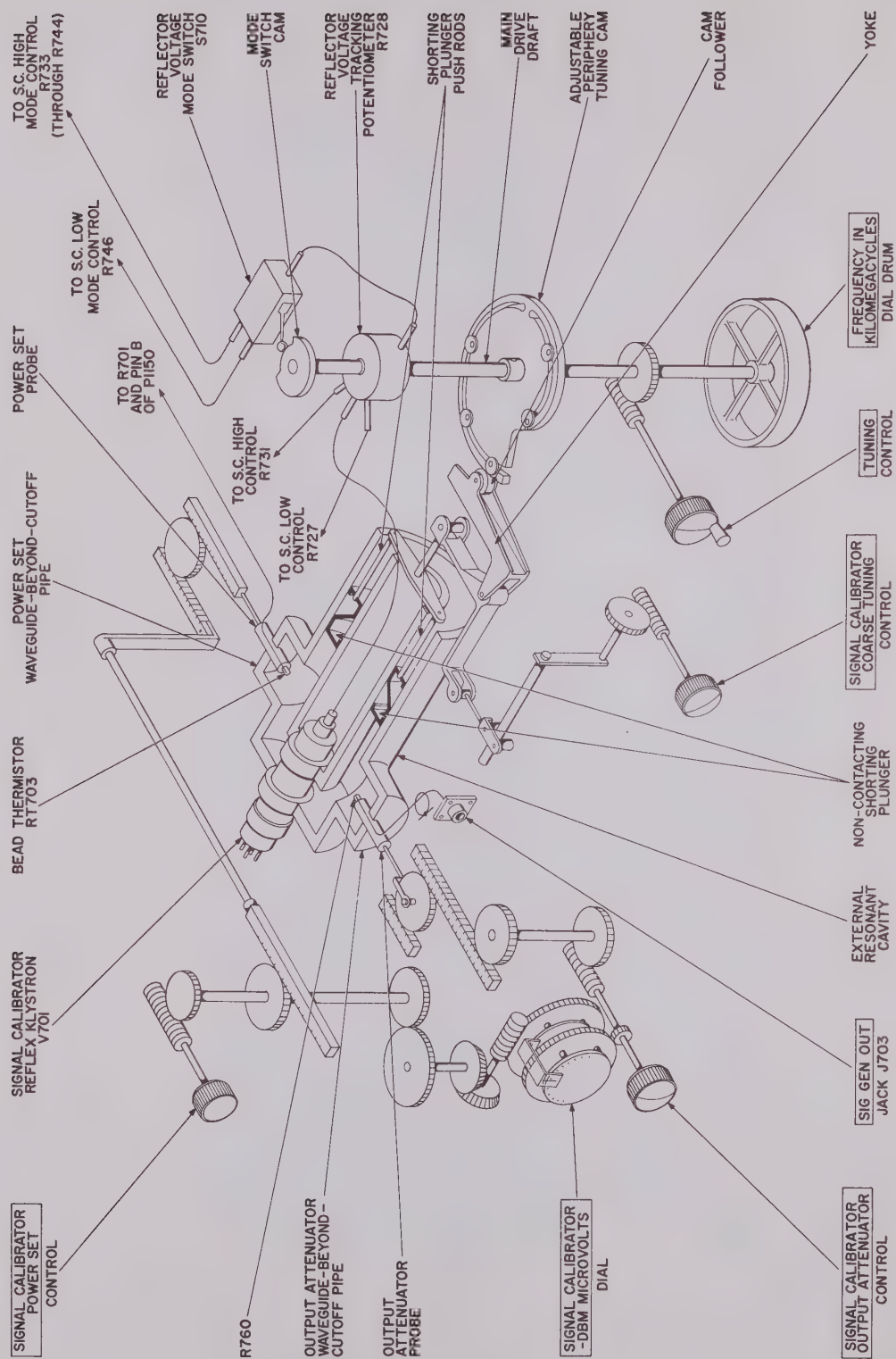


Figure 3-7. Signal Calibrator V701, Simplified Electro-mechanical Diagram

3-33. Incremental adjustment of the signal calibrator external resonant cavity shorting plunger position, independent of the TUNING control and precision mechanical drive system, is accomplished by the SIGNAL CALIBRATOR COARSE TUNING control through a worm and gear assembly. This facility enables the cavity to be precisely tuned to a frequency 260 mc away from that of the first local oscillator and, at the same time, to the exact frequency to which the preselector is tuned.

3-34. SIGNAL CALIBRATOR REFLECTOR VOLTAGE TRACKING CIRCUIT.

3-35. In a manner similar to that for the first local oscillator (see paragraph 3-23), the signal calibrator reflector voltage is controlled by wire-wound potentiometer R729. Resistors R744, R767, and R775 are selected to insure that the proper frequency-versus-voltage characteristics (see figure 3-6) are obtained for the reflector electrode. Potentiometers R727, R731, R733, and R746, which are screwdriver adjusted, in conjunction with the SIGNAL CALIBRATOR FINE TUNING control (R747A and R747B) limit the maximum and minimum voltages applied to the reflector voltage tracking potentiometer and permit fine adjustment of the reflector voltage when tuning the signal calibrator. Mode switching is accomplished in the vicinity of 9,100 mc by mode switch S710, which is actuated by a teflon cam mounted on the control shaft of reflector voltage tracking potentiometer R729.

3-36. SIGNAL CALIBRATOR POWER SET AND OUTPUT ATTENUATOR CONTROLS.

3-37. The SIGNAL CALIBRATOR POWER SET and SIGNAL CALIBRATOR OUTPUT ATTENUATOR controls determine the positions of the thermistor probe assembly within the power set waveguide-beyond-cutoff pipe and the output attenuator probe within the output attenuator waveguide-

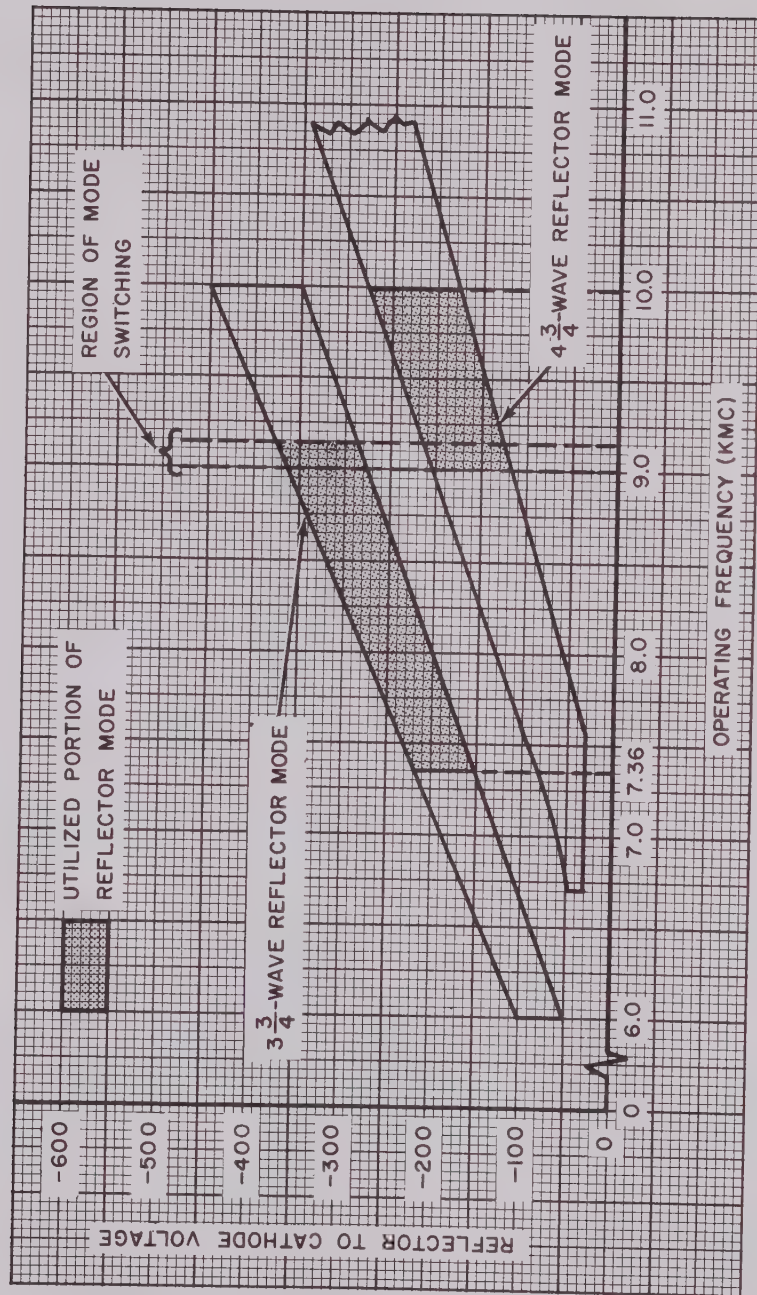


Figure 3-8. Signal Calibrator Frequency Versus Reflector Voltage Characteristic Curve

beyond-cutoff pipe, respectively. The SIGNAL CALIBRATOR POWER SET control simultaneously adjusts the position of the thermistor probe within the power set pipe and the position of the power set indicator hairline, as shown in figure 3-7. The SIGNAL CALIBRATOR OUTPUT ATTENUATOR control, which functions independently of the SIGNAL CALIBRATOR POWER SET control, simultaneously adjusts the position of the output attenuator probe within its pipe and the position of the -DBM MICROVOLTS dial, as shown in figure 3-7.

3-38. Rotation of the SIGNAL CALIBRATOR POWER SET control adjusts the position of the bead thermistor (see paragraph 3-39), and hence determines the amount of r-f power absorbed by the probe. This control is adjusted until the "cal" indication is obtained on the power monitor meter. When this adjustment has been made, the r-f power extracted by the output attenuator probe and coupled to the SIG GEN OUT jack can be read directly from the -DBM MICROVOLTS dial with an accuracy of ± 1 db.

3-39. THERMISTOR BRIDGE CIRCUIT.

3-40. The r-f power monitoring circuit consists of a Wheatstone-type bridge employing a variable resistance element (thermistor) as one of its arms. A thermistor has a negative temperature coefficient of resistance (i.e., its resistance decreases as its temperature increases, and vice versa). Changes in thermistor temperature (and hence resistance) are governed by three factors: thermal changes in its environment, the current flowing through it, and the r-f energy it absorbs.

3-41. By controlling two factors, namely the thermal change in its environment and the current passing through it, the thermistor can

be used to measure r-f energy by utilizing the change in resistance caused by the r-f energy it has absorbed.

3-42. Two types of thermistors are employed in the bridge and associated compensating circuitry (see figure 5-4); the bead type (RT703), which has a small mass and is affected by all the factors mentioned above, and the disc type (RT701 and RT702), which has a relatively greater mass and is highly sensitive to its environmental temperature while relatively insensitive to the current flowing through it.

3-43. The basic bridge circuit, which consists of resistors R701, R702, and R703 and thermistor RT703 (which is part of the thermistor probe assembly located in the power set waveguide-beyond-cutoff pipe), is balanced by adjusting power monitor meter ZERO SET control R312 when FUNCTION SEL switch S304 is in the ZERO SET position. Bridge Coarse Int. Adj. control R709 is factory set to permit the power monitor meter ZERO SET control to cover the entire range of the Tuning Unit. After the power monitor meter has been zero-set, and the FUNCTION SEL switch set to the CAL SIG GEN position, any r-f power fed into the power set waveguide-beyond-cutoff pipe will be absorbed by the bead thermistor, thereby changing its resistance and unbalancing the bridge.

3-44. The bridge and its associated circuitry is so designed that, at a particular frequency, the thermistor probe must be inserted a definite amount within the power set waveguide-beyond-cutoff pipe for the thermistor to absorb one milliwatt of r-f power. When one milliwatt is absorbed, the power monitor meter pointer will deflect to an indication of "cal," as indicated on the correction curves supplied with the Model FIM-X2 Tuning Unit.

3-45. Disc thermistors RT701 and RT702, which are located on a thermistor mount attached to the power set pipe, are compensating devices. RT701, in combination with resistors R704 and R706, acts to correct any d-c unbalance due to changes in ambient temperature. RT702, in combination with resistors R707 and R708, acts to correct any change in power monitor meter sensitivity caused by changes in ambient temperature.

3-46. PROTECTIVE DIODES CR701 AND CR702.

3-47. Protective diodes CR701 and CR702, which are connected between the reflector and cathode of first local oscillator V702 and signal calibrator V701, respectively, as shown in figure 5-4, are employed to prevent possible damage to the reflex klystrons should the reflectors somehow become positive with respect to the cathode. Reference to the schematic diagram, figure 5-4, shows that the cathode of protective diode CR701 is connected directly to the cathode of V702 (similarly for CR702 and V701), to which the anode voltage is applied. Since the anode of CR701 is connected directly to the reflector of V702 (the same holds true for CR702 and V701), any circuit disturbance causing the reflector to become more positive than the cathode will drive the protective diode into conduction. In this manner, the maximum positive voltage appearing at the reflector (with respect to the cathode) will be the small voltage drop across the conducting protective diode. This circuitry thereby prevents the possible destruction of the reflex klystron when the reflector accidentally becomes more positive than the cathode.

3-48. GRID BIAS ADJUST CONTROLS.

3-49. The reflex klystron grid bias, which determines the amount of current drawn by the tube, and hence the r-f power developed, is controlled by a network of dropping resistors and a screwdriver adjusted potentiometer. Normal operating bias voltages for both the first local oscillator and the signal calibrator varies between +8 and +10 volts with respect to the cathode (see table 3-1). The signal calibrator grid bias voltage is obtained from the anode supply via the voltage divider network comprised of resistors R711, R712, R777, R778, R782, and S.C. Bias control R713. In a similar fashion, the first local oscillator grid bias voltage is obtained from the voltage divider network comprised of resistors R716, R717, R772, R779, R781, and L.O. Bias control R714.

3-50. When the FUNCTION SEL switch is set to either the ZERO SET or OPERATE position, the voltage appearing at the control grid of V701 lies between -1,250 and -1,850 volts, as determined by the voltage divider network comprised of resistors R748, R749, R750, and R752, which are connected across the reflector and anode supplies. This negative voltage is sufficient to bias the reflex klystron beyond cutoff.

3-51. CURRENT ADJUST CONTROLS.

3-52. Low I Adj. control R743 and High I Adj. control R766, in conjunction with switch S709B, are employed to maintain the current drawn from the reflector supply at a constant level of 7 ma. These controls, which are screwdriver adjusted, enable the afc amplifier (see paragraph 3-87) to operate at its optimum point. These current adjusting controls are employed in each Tuning Unit, thereby permitting the afc amplifier to perform independently of the Tuning Unit in use.

3-53. PRECISION MECHANICAL DRIVE SYSTEM.

3-54. The precision mechanical drive system (UNIDIAL[®]) simultaneously tracks the preselector, the first local oscillator external resonant cavity, the first local oscillator reflector voltage, the signal calibrator external resonant cavity, the signal calibrator reflector voltage, and the FREQUENCY IN KILOMEGACYCLES dial with rotation of the TUNING control. This drive system consists of a main drive shaft three tuning cams (two of which are of the adjustable periphery type¹), and a precision gear assembly. Through the precision mechanical drive system the rotational motion imparted to the TUNING control by the operator is converted to the required translational motion required to track the preselector and external resonant cavities as well as the rotational motion necessary to drive the reflector voltage tracking potentiometers, the FREQUENCY IN KILOMEGACYCLES dial, and the mode switch cams.

3-55. Rotation of the preselector tuning cam (see figure 3-3), which is of the fixed periphery type, causes its cam follower to drive the preselector yoke. The yoke, in turn moves the preselector tuning plungers, thereby determining the physical wavelength of the preselector cavities.

3-56. In a manner similar to that for the preselector, the first local oscillator and signal calibrator tuning cams, which are both of the adjustable periphery type, drive their respective cam followers. These, in turn, move the yokes which position the movable non-contacting shorts within the signal calibrator and first local oscillator external resonant cavities, as shown in figures 3-5 and 3- 7 .

¹ U. S. Patent No. 2,824,466.

3-57. Because simultaneous tracking of all three Tuning Unit components, namely the preselector, the first local oscillator, and the signal calibrator, would require a myriad of tracking adjustments, the precision mechanical drive system tightly tracks only the preselector and first local oscillator simultaneously, while the signal calibrator is loosely tracked with the above two components. In this manner, the frequency difference between the first local oscillator and the preselector is always maintained at exactly 260 mc. The operating frequency of the signal calibrator is adjusted, by means of the SIGNAL CALIBRATOR COARSE TUNING and SIGNAL CALIBRATOR FINE TUNING controls, to the exact frequency of the preselector (see paragraphs 3-30 and 3-34).

3-58. DETAILED THEORY OF OPERATION, BASIC UNIT.

3-59. The Basic Unit is the control and monitoring section of the FIM-2 system. It contains an electrically operated coaxial r-f transfer switch, two electrically operated coaxial input attenuator switches and six calibrated coaxial r-f attenuators, a 260/140-mc preamplifier, a crystal-controlled local oscillator, a 140-mc i-f attenuator, a 140/40-mc i-f amplifier, an afc-i-f amplifier, a multiple position output selector switch and the associated weighting circuitry for the measurement of the average, quasi-peak, slideback-peak, and peak measurements of incoming r-f signals, a calibrated output voltmeter for visually displaying the magnitude of the measured signal, an audio-metering chassis, a meter adjust board and power monitor meter for monitoring the operating voltages and currents generated within the equipment, a low-voltage power supply, a high-voltage power supply, and an afc amplifier. These components of the Basic Unit are described in detail in the following paragraphs.

3-60. COAXIAL R-F TRANSFER SWITCH S1101.

3-61. Electrically operated coaxial r-f transfer switch S1101 (see figures 3-2 and 5-6) is connected between CAL IN jack J311, RF IN jack J312, and the input to coaxial input attenuator switch S1102. Operation of S1101 is dependent upon the position of FUNCTION SEL switch S304, as described below.

a. When the FUNCTION SEL switch is in the ZERO SET position, both switching relays of coaxial r-f transfer switch S1101 are unenergized, forming open circuits between both the CAL IN and RF IN jacks and the receiver section of the FIM-2. Simultaneously, the control grid of the signal calibrator reflex klystron is biased beyond cutoff, preventing the generation of r-f energy. Under these conditions, adjustment of the power monitor meter ZERO SET control permits zero-setting the power monitor meter.

b. When the FUNCTION SEL switch is in the CAL SIG GEN position, +28-volts is applied to the terminals of switching relay A, causing the relay to become energized and coupling the output of the signal calibrator to the input of the r-f attenuators. The r-f signal from the RF IN jack is open-circuited and cannot be transferred to the remainder of the Basic Unit r-f circuitry.

c. When the FUNCTION SEL switch is in the OPERATE position, +28-volts is applied to the terminals of switching relay B, causing the relay to become energized and coupling the r-f signal under measurement from the RF IN jack to the input of the r-f attenuators. As in the ZERO SET position, the signal calibrator is once again biased beyond cutoff.

3-62. R-F INPUT ATTENUATOR.

3-63. The r-f input attenuator network (see figures 3-2 and 5-6) consists of coaxial input attenuator switches S1102 and S1103, six calibrated coaxial r-f attenuators, and the cable assemblies necessary to interconnect these components. The amount of r-f attenuation inserted by this network between the r-f signal (either from the calibrated antenna through the RF IN jack or from the signal calibrator through the CAL IN jack) is controlled by the r-f INPUT ATTENUATOR DB push-button switches, S305, as listed below in table 3-2.

TABLE 3-2. R-F ATTENUATION AS A FUNCTION OF PUSH-BUTTON SWITCH DEPRESSED.

R-f INPUT ATTENUATOR DB Push-button Switch Depressed	Calibrated Coaxial Input Attenuator(s) Inserted	Total R-f Attenuation Inserted
0X1	None	0 db
20X10	AT1100	20 db
40X100	AT1101 and AT1102	40 db
60X1000	AT1103, AT1104, and AT1105	60 db

3-64. The signal that is available at the output connector of coaxial input attenuator switch S1103 is then coupled to the front panel ATTEN OUT jack J307 via r-f cable assembly W304.

3-65. 260/140-MC PREAMPLIFIER.

3-66. The 260/140-mc preamplifier (see figures 3-2, 5-5, and 5-8) is a combination fixed-tuned two-stage grounded-grid amplifier and frequency converter. It generates the second intermediate frequency

signal by heterodyning the first i-f signal with the 120-mc output of the crystal-controlled local oscillator.

3-67. The signal coupled through input connector J801 consists not only of the 260-mc first i-f signal, but also the sum and difference frequencies of the r-f signal under measurement and the harmonic outputs of the first local oscillator. These signals ride on a d-c level created by the first crystal mixer. The d-c current is returned to the first crystal mixer through the low-pass filter network consisting of inductors L809, L812, and L815 and capacitors C805 and C810.

3-68. The remainder of the signal is then applied to the cathode of grounded-grid i-f amplifier V801 through a broadly tuned impedance matching network comprised of tapped coil L801 and capacitors C801 and C818. This network filters out the undesired responses created by the harmonics of the first local oscillator and passes only the desired first i-f signal which is centered at 260 mc.

3-69. The output of V801 is transformer coupled via T801, which is tuned to 260 mc, to the cathode of grounded-grid i-f amplifier V802 for another stage of amplification. The output of V802 is then applied to the primary of transformer T802, which is also tuned to 260 mc.

3-70. The 120-mc output of the crystal-controlled local oscillator (see paragraph 3-89) is applied through input connector J803 to the voltage divider network comprised of resistors R803 and R804. This network adjusts the amplitude of the 120-mc signal to the optimum value required for mixing. This signal is then fed to second crystal mixer CR801 through the secondary of T802. CR801, being a non-linear device, heterodynes the 260- and 120-mc signals to produce their sum and difference frequencies. The 140-mc difference signal

is coupled through the bandpass filter consisting of inductor L808 and capacitor C817 and applied to output jack J802. The second i-f signal is then coupled to input connector J326 of the 140-mc i-f attenuator (see paragraph 3-71) via i-f cable assembly W1153.

3-71. 140-MC I-F ATTENUATOR.

3-72. The 140-mc i-f attenuator (see figures 3-2, 5-5, and 5-8) consists of five compensated pi-section resistive attenuators, each individually controlled by an i-f Input Attenuator Db push-button switch. The amount of i-f attenuation inserted into the i-f line is adjustable from 0 to 20 db in 1-db steps. The output, which is available at J325, is then coupled to input jack J900 of the 140/40-mc i-f amplifier (see paragraph 3-73) through i-f cable assembly W1155.

3-73. 140/40-MC I-F AMPLIFIER.

3-74. The 140/40-mc i-f amplifier (see figures 3-2, 5-5, and 5-8) contains a 140-mc stagger-tuned section, a mixer, a 40-mc stagger-tuned section, a power amplifier, two detectors, and two cathode followers.

3-75. The second i-f signal from the 140-mc i-f attenuator is coupled through input jack J900 and coupling capacitor C900 and applied to the control grid of V900, the first stage of a three-stage stagger-tuned amplifier section. The output of V900, taken across the 143-mc plate tank circuit comprised of inductor L903 and capacitor C907, is coupled to the control grid of V901. The output of this second stage is taken across the 137-mc plate tank circuit consisting of inductor L906 and capacitor C916 and fed to the control grid of the third and final stage, V902. The output of V902 is taken across inductor L911, which, in conjunction with the stray capacitance as-

sociated with the inductor, is tuned to 140 mc, and applied to the control grid of third mixer V903.

3-76. Simultaneously, the 180-mc output of the crystal-controlled local oscillator (see paragraph 3-89) is applied to the primary of transformer T900, which is tuned to 180 mc, through input jack J901. The 180-mc signal appearing across the secondary of T900 is applied through coupling capacitor C927 to the control grid of V903. This 180-mc signal and the 140-mc output of V902 are mixed within V903 to yield the third and final i-f signal which is centered at 40 mc.

3-77. The output of third mixer V903 is taken across the 42.3-mc plate tank circuit comprised of inductor L915 and capacitor C934 and applied to the control grid of V904, the first stage of a three-stage stagger-tuned amplifier section. The output of V904 is taken across the 37.7-mc plate tank circuit comprised of inductor L919 and capacitor C954 and applied to the control grid of V905. The output of this stage is taken across the 42.6-mc plate tank circuit consisting of inductor L923 and capacitor C952 and applied to the control grid of V906, the last stage of amplification in the stagger-tuned amplifier section. The output of V906 is taken across the 37.5-mc plate tank circuit consisting of inductor L929 and capacitor C959 and applied to the control grid of power amplifier V907.

3-78. The 40-mc center frequency output of V907 is then fed to three circuits, as described below.

a. The output of V907 is taken across the primary of transformer T901, which is tuned to 40 mc, and applied to the plate of video detector V908B. The detected output appearing at the cathode is then applied to the i-f filter and video peaking network comprised of capacitor C969 and inductor L935, taken across resistor R933 and fed to the control grid of video cathode follower V909A.

V909A acts as an impedance matching device and feeds VIDEO OUT jack J301 and AUDIO OUT jack J305, the latter through the audio amplifier circuitry of the audio-metering chassis (see paragraph 3-96), via output jack J904.

b. The output of V907 is also taken across inductor L936 and applied to the cathode of metering detector V908A. The detected output appearing at the plate is coupled through the i-f filter and series peaking network comprised of capacitor C972, inductor L950, and resistor R990, taken across load resistor R938, and directly coupled to the control grid of metering cathode follower V909B. The output of V909B, which serves as an impedance matching device, is then applied, via output jack J903 and video cable assembly W1157, to the wiper arm of OUTPUT switch S301C, which applies the detected metering signal to the selected weighting circuit (see paragraph 3-101).

c. The output of V907 is also taken across the secondary of transformer T901 and coupled through a 3-db pad, comprised of resistors R928, R929, and R931, and applied through output jack J902 and i-f cable assembly W1151 to the input of the afc-i-f amplifier (see paragraph 3-80).

3-79. The overall gain of the 140/40-mc i-f amplifier is controlled by IF GAIN control R306A, which adjusts the d-c voltage appearing at the cathodes of V901 and V902. Linear operation is obtained through Scale Tracking control R368 (located on the meter adjust board), which varies the cathode load of V904 and V905. Further control of the linearity of the amplifier is provided by an agc signal applied to the control grids of V900, V904, and V905. This agc signal is obtained from the audio-metering chassis (see paragraph 3-96).

3-60. AFC-I-F AMPLIFIER.

3-81. The afc-i-f amplifier (see figures 3-2, 5-5, and 5-8) consists of two stages of amplification, two series limiters, two parallel drivers, and two crystal discriminator networks, and is employed to generate a d-c error signal when the third i-f signal differs from the desired value of 40 mc. The d-c error signal is then applied to the afc amplifier (see paragraph 3-87), which supplies a corrective voltage to the first local oscillator reflector.

3-82. The nominally 40-mc signal received from the 140/40-mc i-f amplifier via input connector J1050 is coupled through a 3-db pad consisting of resistors R1050, R1051, and R1052, and applied to the primary of transformer T1050, which is tuned to 40 mc. The signal appearing across the secondary is coupled to the control grid of V1050. The voltage across inductor L1050, which, in conjunction with its associated stray capacitance, is tuned to 40 mc, is fed to the control grid of V1051. The output of this stage is taken across inductor L1052, which is also tuned to 40 mc through its stray capacitance, and coupled to the control grid of limiter V1052.

3-83. The 40-mc signal is clipped within limiter V1052, which has its control grid driven beyond cutoff during a portion of the negative half-cycle of the signal. This clipping action reduces the noise level of the negative half-cycle. The output of V1052, which has been shifted 180-degrees, is then applied to the control grid of limiter V1053, which clips the other half-cycle of the 40-mc signal. The output of V1053 is taken across the 40-mc tuned plate circuit comprised of inductor L1056, resistor R1069, and the associated stray capacitance, and fed to the parallel control grids of drivers V1054 and V1055.

3-84. The output of V1054 is taken across the 38.25-mc tuned plate circuit consisting of inductor L1058, capacitor C1069, and resistor R1076, and applied to the discriminator network containing crystal diode CR1051 and inductor L1065. The output of V1055 is taken across the 41.75-mc tuned plate circuit comprised of inductor L1061, resistor R1081, and capacitor C1073, and fed to the discriminator network consisting of crystal diode CR1050 and inductor L1064.

3-85. The detected outputs of the discriminator networks are then filtered by the pi-section filters consisting of capacitors C1079, C1082, C1083, and C1084 and inductors L1066 and L1068. These filters produce a pure d-c voltage across resistor R1083. The magnitude and polarity of this voltage is proportional to the frequency deviation from the desired 40-mc third i-f center frequency, as follows.

a. When the third i-f signal applied to the afc-i-f amplifier is exactly 40 mc, the outputs of both discriminators are equal, both in magnitude and polarity. This condition results in no afc error signal, for the incoming third i-f is 40 mc.

b. When the third i-f signal applied to the afc-i-f amplifier is slightly greater than 40 mc, the output of the 41.75-mc driver, V1055, will be greater than that of V1054. In this manner the output of the high-frequency discriminator (CR1050 and its associated circuitry) will be greater than that of the low-frequency discriminator. This results in a d-c error signal that is more positive at pin A of connector P1051 than at pin D.

c. Conversely, when the third i-f signal applied to the afc-i-f amplifier is slightly less than 40 mc, the output of the 38.25-mc driver, V1054, will be greater than that of V1055. In this manner the output of the low-frequency discriminator (CR1051 and its associated circuitry) will be greater than that of the high-frequency dis-

criminators, resulting in a d-c error signal that is more positive at pin D of connector 11051 than at pin A.

3-86. The d-c error signal thus generated is applied to the afc amplifier (see paragraph 3-87). This error signal is available at all times and is independent of the position of AFC switch S306.

3-87. AFC AMPLIFIER.

3-88. Afc amplifier V209 (see figures 3-2 and 5-7) and its associated circuitry is provided to permit automatic frequency control (afc) of the first local oscillator when the AFC switch is set to the IN position. When AFC switch S306 is set to the OUT position, relay K201 is unenergized and the output of the reflector supply (see paragraph 3-127) is applied directly to the first local oscillator reflector tracking circuit (see paragraph 3-23). When the AFC switch is set to the IN position, however, relay K201 is energized, causing the d-c error signal from the afc-i-f amplifier to be amplified by V209. The amplified error signal is superimposed upon the reflector supply voltage, the resulting reflector voltage level then causes the operating frequency of the first local oscillator to shift in that direction which will return the first i-f signal to 260 mc (and hence the third i-f signal to 40 mc).

3-89. CRYSTAL-CONTROLLED LOCAL OSCILLATOR.

3-90. The crystal-controlled local oscillator (see figures 3-2, 5-5, and 5-8) consists of three sections: a 30-mc oscillator and frequency doubler, a frequency doubler which produces the 120-mc signal applied to the 260/140-mc preamplifier (see paragraph 3-65), and a frequency tripler which provides the 180-mc signal applied to the 140/40-mc i-f amplifier (see paragraph 3-73).

3-91. The 30-mc oscillator and frequency doubler section consists of oscillator V850A, frequency doubler V850B, and crystal Y850. The output of V850A is taken across the 30-mc tuned plate circuit comprised of inductor L851 and capacitor C851 and coupled to the control grid of frequency doubler V850B. The output of V850B, appearing across cathode resistor R851, is coupled through 30-mc crystal Y850 to the cathode of V850A, thereby sustaining oscillations at the desired frequency of 30 mc.

3-92. The second harmonic component of the output of V850B is taken across the 60-mc tuned plate circuit consisting of inductor L852 and capacitor C853 and applied to the control grid of amplifier V851. The amplified 60-mc output is taken across the 60-mc tuned plate circuit comprised of inductor L854, capacitor C856, and resistor R854, and coupled to the control grids of both frequency doubler V853 and frequency tripler V852.

3-93. The output of V853 is taken across the 120-mc tuned secondary of transformer T851 and applied through output jack J851 and i-f cable assembly W1154 to the 260/140-mc preamplifier.

3-94. The output of V852 is taken across the 180-mc tuned secondary of transformer T850 and applied through output connector J850 and i-f cable assembly W1152 to the 140/40-mc i-f amplifier.

3-95. Artificial modulation of the second i-f signal is accomplished by superimposing a 1,000-cps audio signal, generated in the audio-metering chassis (see paragraph 3-98), on the control grid of frequency doubler V853. The magnitude of this aural aid signal is controlled by AURAL AID control R308B and switch S302.

3-96. AUDIO-METERING CHASSIS.

3-97. The audio-metering chassis (see figures 3-2, 5-5, and 5-8) contains the circuitry required to develop an aural tuning aid signal of 1,000 cps, an audio amplifier, and the metering circuitry required to convert the output of the weighting circuits (see paragraph 3-101) to a signal suitable for application to output meter M301.

3-98. AURAL AID CIRCUIT. The aural aid circuit consists of cathode follower V1004A, audio oscillator V1004B, and feedback amplifier V1005. This circuit is energized when AURAL AID control R308A is rotated clockwise beyond its "off" position, thereby closing AURAL AID switch S302 and applying +130 volts to the plates of these tubes.

3-99. Audio oscillator V1004B is a cathode follower having its output taken across resistor R1014. This signal is applied to the RC phase-shift network consisting of resistors R1015, R1016, and R1021 and capacitors C1006, C1007, and C1008. This network produces a 180-degree phase shift when the signal applied to it is 1,000 cps. Its output is applied to the control grid of feedback amplifier V1005, which shifts the phase of the signal another 180-degrees. The resulting output of V1005 is coupled back to the control grid of audio oscillator V1004B, thereby sustaining oscillations, and to the control grid of audio amplifier V1004A. The cathode load resistance, AURAL AID control R308A, determines the amplitude of the 1,000-cps signal applied to the crystal-controlled local oscillator (see paragraph 3-89) for artificial modulation of the i-f signal.

3-100. AUDIO AMPLIFIER CIRCUIT. The audio amplifier circuit consists of audio amplifier V1001A and audio power amplifier V1002. This circuit amplifies the modulation envelope of the detected video signal obtained from video cathode follower V909A (see paragraph 3-78)

when the OUTPUT switch is in the AVERAGE, QUASI-PEAK, or SLIDEBACK position. Audio amplifier V1001A is a self-biased triode amplifier whose cathode resistor is unbypassed, thereby introducing negative feedback which results in less distortion of the signal being amplified. The output of V1001A is coupled to the control grid of audio power amplifier V1005, a conventional pentode power amplifier having an impedance matching transformer as its load. The output of V1005, which appears across the secondary of T1001, is coupled through output connector J1002 and cable assembly W308 to AUDIO OUT jack J308, where the modulation may be monitored through a 600-ohm headset.

3-101. METERING CIRCUIT. The metering circuit consists of relay K1001, pulse detector V1003B, d-c amplifiers V1001B and V1003A, and OUTPUT switch S301 and its associated circuitry.

3-102. When OUTPUT switch S301 is set to the ZERO SET position, the detected 40-mc signal from metering cathode follower V909B (see paragraph 3-89) is coupled through S301C to the wiper of S301D. Since there is no connection to pin 1 of S301D, no signal is applied to the d-c amplifiers. This position of the OUTPUT switch permits zero-setting of output meter M301 by means of output meter ZERO SET control R310.

3-103. When the OUTPUT switch is in the AVERAGE position, the detected metering signal is coupled through deck C to the average weighting circuit consisting of resistor R321 and capacitor C307. This circuit has a fast charge time and a slow discharge time for the detected i-f carrier and therefore responds to the peak of the detected i-f carrier. The discharge time is fast, however, for any modulation component, so that the output of the weighting circuit will follow the modulation. The resultant output will therefore be the average value of the modulation. This signal is coupled, through

S301B, to the audio-metering chassis connector P1003, pin H.

3-104. When the OUTPUT switch is in the QUASI-PEAK position, the detected 40-mc signal is coupled through deck C to the quasi-peak weighting circuit comprised of crystal diode CR303, resistors R323 and R324, and capacitors C308 and C309. This circuit has a slow charge time for the applied i-f carrier and an intermediate charge time for conventional pulse repetition rates. The discharge time, however, is slow for both. The amplitude response of this weighting circuit is thus directly proportional to the prf of the detected 40-mc signal (when the amplitude of the signal remains constant), and indicates the interference capability (nuisance value) of the signal. The output of this circuit is coupled through S301B to the audio-metering chassis via pin H of P1003.

3-105. When the OUTPUT switch is in the SLIDEBACK position, the detected 40-mc signal is coupled through deck C to the slideback-peak weighting circuit comprised of resistor R325, capacitor C301, crystal diode CR301, and SLIDEBACK control R306B. This circuit is similar to the average weighting circuit in that its time constants are alike. The SLIDEBACK control is adjusted, in conjunction with the AUDIO GAIN and AURAL AID controls, so that the signal heard in the headset just vanishes. When this occurs, the biasing voltage obtained from the -140-volt supply is equal to the peak value of the detected 40-mc signal. This bias voltage is then coupled to the audio-metering chassis through pin H of P1003.

3-106. When the OUTPUT switch is in the PEAK position, the detected 40-mc signal is coupled through deck C directly to deck B. The signal is then applied to pin H of audio-metering chassis connector P1003.

3-107. The signal coupled to pin H of audio-metering connector P1003 is applied to the junction of relay K1001, pin 7, and the cathode of pulse detector V1003B. When the OUTPUT switch is in the ZERO SET, AVERAGE, or QUASI-PEAK position, relay K1001 is unenergized and the output signal from the weighting circuit is coupled to the grid of d-c amplifier V1001B. For the other two positions of the OUTPUT switch, namely SLIDEBACK and PEAK, the signal is coupled through pulse detector V1003B and the weighting circuit comprised of resistor R1011 and capacitors C1004 and C1005 to the control grid of d-c amplifier V1001B.

3-108. D-c amplifier V1001B is a cathode follower whose output is taken across resistor R1008. The output signal serves the dual function of driving d-c amplifier V1003A and providing an agc signal for the 140/40-mc i-f amplifier (see paragraph 3-73). The output of V1003A is obtained between the wiper arm of output meter ZERO SET control R310 and ground, and is applied through Meter Sensitivity control R351 (see paragraph 3-113) to output meter M301. The output meter scales are calibrated to permit direct evaluation of the strength of the signal being measured and is calibrated in microvolts, decibels above one microvolt, and decibels above one microvolt per megacycle.

3-109. The small contact potential that exists between the plate and cathode of pulse detector V1003B is compensated for by contact potential adjust control R1021. In this manner, the small potential present does not cause errors in the measurement of either slideback-peak or peak levels of incoming r-f signals.

3-110. METER ADJUST BOARD.

3-111. The meter adjust board (see figures 5-5 and 5-8) contains the various controls and components required to (a) cancel the contact potential that exists between the plate and cathode of metering detector V908A (see paragraph 3-73), (b) track the output meter over its scale, and (c) monitor the various voltages and currents developed within the system.

3-112. The low set controls (avg. Low Set control R362, Q.P. Low set control R361, Slideback Low Set control R359, and Peak Low Set control R354) are provided for the development of the small potential equal to but of opposite polarity to the contact potential developed between the plate and cathode of metering detector V908A. These controls are adjusted individually, after the output meter has been zero-set, in conjunction with the OUTPUT switch so that output meter M301 will indicate no deflection when there is no signal coupled to the IF IN jack. The value of these voltages are obtained through the corresponding test points provided, as follows: average test point, TP358; quasi-peak test point, TP357, slideback-peak test point, TP356; peak test point, TP352.

3-113. The deflection of the output meter pointer for a given output of d-c amplifier V1003A is adjustable by means of Meter Gain control R351. Rotation of this screwdriver adjusted control varies the sensitivity of the output meter by inserting series resistance in the meter circuit.

3-114. Scale Tracking control R368 is provided to permit adjusting the grid-to-cathode bias voltage of i-f amplifiers V904 and V905 (see paragraph 3-73) so that the 140/40-mc i-f amplifier operates within its linear region. The bias voltage developed is available for measurement at test point TP359.

3-115. Test Selector switch S351, in conjunction with power monitor meter M302, is provided as a rapid means of monitoring the various operating voltages and currents generated by the FIM-2. This switch enables the operator to monitor the following when the Basic Unit is removed from its dust cover

- a. signal calibrator thermistor bridge current
- b. first crystal mixer current
- c. reflector supply
- d. either the first local oscillator anode current (when the FUNCTION SEL switch is in the OPERATE position) or both the first local oscillator and signal calibrator anode currents (when the FUNCTION SEL switch is in the CAL SIG GEN position).
- e. anode supply
- f. +130-volt supply
- g. +105-volt supply
- h. -140-volt supply

NOTE:

The Test Selector switch is factory set in the Operate position and should be kept in that position whenever the FIM-2 is being used to perform its normal functions. The switch is primarily an aid for localizing malfunctions to an individual segment of the system.

3-116. LOW-VOLTAGE POWER SUPPLY.

3-117. The low-voltage power supply (see figures 3-9, 5-6, and 5-8) contains the +130-volt, +105-volt, -140-volt, and -6.3-volt regulated supplies, in addition to producing the necessary voltages for the filaments of the vacuum tubes of the crystal-controlled local oscillator, the afc-i-f amplifier, and the anode supply.

3-118. +130-VOLT SUPPLY. The +130-volt supply (see figures 3-9 and 5-6) is a conventional series-type degenerative voltage regulator

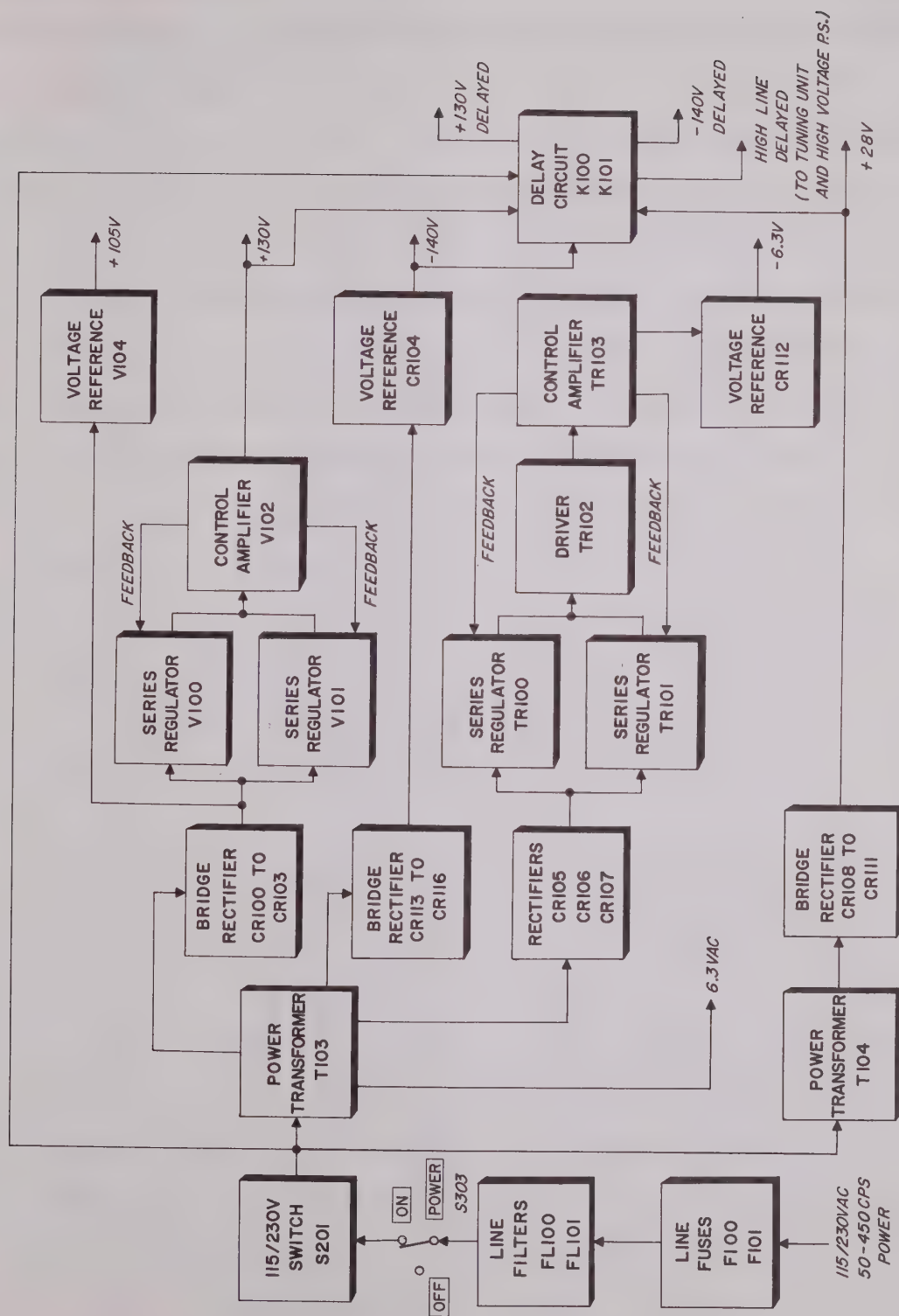


Figure 3-9. Low-Voltage Power Supply, Functional Block Diagram

consisting of series regulators V100 and V101 and control amplifier V102. The bias on the control grid of V102 is adjusted by +130V Adj control R114 to that value necessary to obtain the desired +130-volt output across capacitor C100B. Variations in output voltage due to fluctuations in either line voltage or load current, or both, are amplified by control amplifier V102. The voltage at the plate of V102 controls the bias on the grids of series regulators V100 and V101, causing the output level of the power supply to return to the desired +130 volts.

3-119. -140-VOLT SUPPLY. The -140-volt supply (see figures 3-9 and 5-6) utilizes the characteristics of a zener diode, voltage reference CR104, to obtain the desired output level of -140 volts. In this manner, the zener region of the diode establishes the voltage regulating level (much the same as a gas-tube voltage regulator). The a-c resistance of the diode in the zener region regulates the output for variations in source voltage and/or load current.

3-120. -6.3-VOLT SUPPLY. The -6.3-volt supply (see figures 3-9 and 5-6) which is basically an emitter follower type of degenerative series regulator, consists of control amplifier TR103, driver TR102, and series regulators TR100 and TR101. The base current of TR103 is adjusted by 6.3V Adj control R121 to that value which produces a -6.3-volt output between pin 1 of R121 and ground. Variations in output voltage due to fluctuations in line voltage and/or load current requirements are sensed by reference diode CR116 which, in conjunction with control amplifier TR103 and driver TR102, adjust the current through series regulators TR100 and TR101, causing the output voltage to return to the desired -6.3-volt level.

3-121. +105-VOLT SUPPLY. The +105-volt supply (see figures 3-9 and 5-6) operates from the +130-volt supply, using gas-tube voltage reference V104 to supply an essentially constant voltage equal to the sustaining voltage of +105 volts.

3-122. TIME DELAY CIRCUIT. The 60-second time delay circuit (see figures 3-9 and 5-6) consists of delay relay K100 and hold relay K101. This circuit is provided to delay the application of power to the anode supply (see paragraph 3-125), thereby preventing cold-cathode emission of the tubes in that supply. The time delay circuit also delays the application of the -140-volt and +130-volt supplies to the audio-metering chassis and the high-voltage power supply.

3-123. HIGH-VOLTAGE POWER SUPPLY.

3-124. The high-voltage power supply (see figures 3-10, 5-7, and 5-8) contains the anode supply, a -600-volt supply (which, in conjunction with the anode supply forms the reflector supply), and the afc amplifier.

3-125. ANODE SUPPLY. The anode supply (see figures 3-10 and 5-7) is a conventional degenerative voltage regulator consisting of series regulators V201 and V202 and control amplifier V203. The Tuning Unit in use determines the output voltage of power transformer T201 by applying the delayed power line voltage to the proper terminals of the primary winding. Thus, when the Model FIM-L2 or FIM-S2 Tuning Unit is in use, the anode supply output voltage is equal to -325 volts; when the Model FIM-M2 Tuning Unit is in use, the anode supply output is -1,000 volts; and when the Model FIM-X2 Tuning Unit is in use, the output is -1,250 volts. In this manner, one anode supply functions as three.

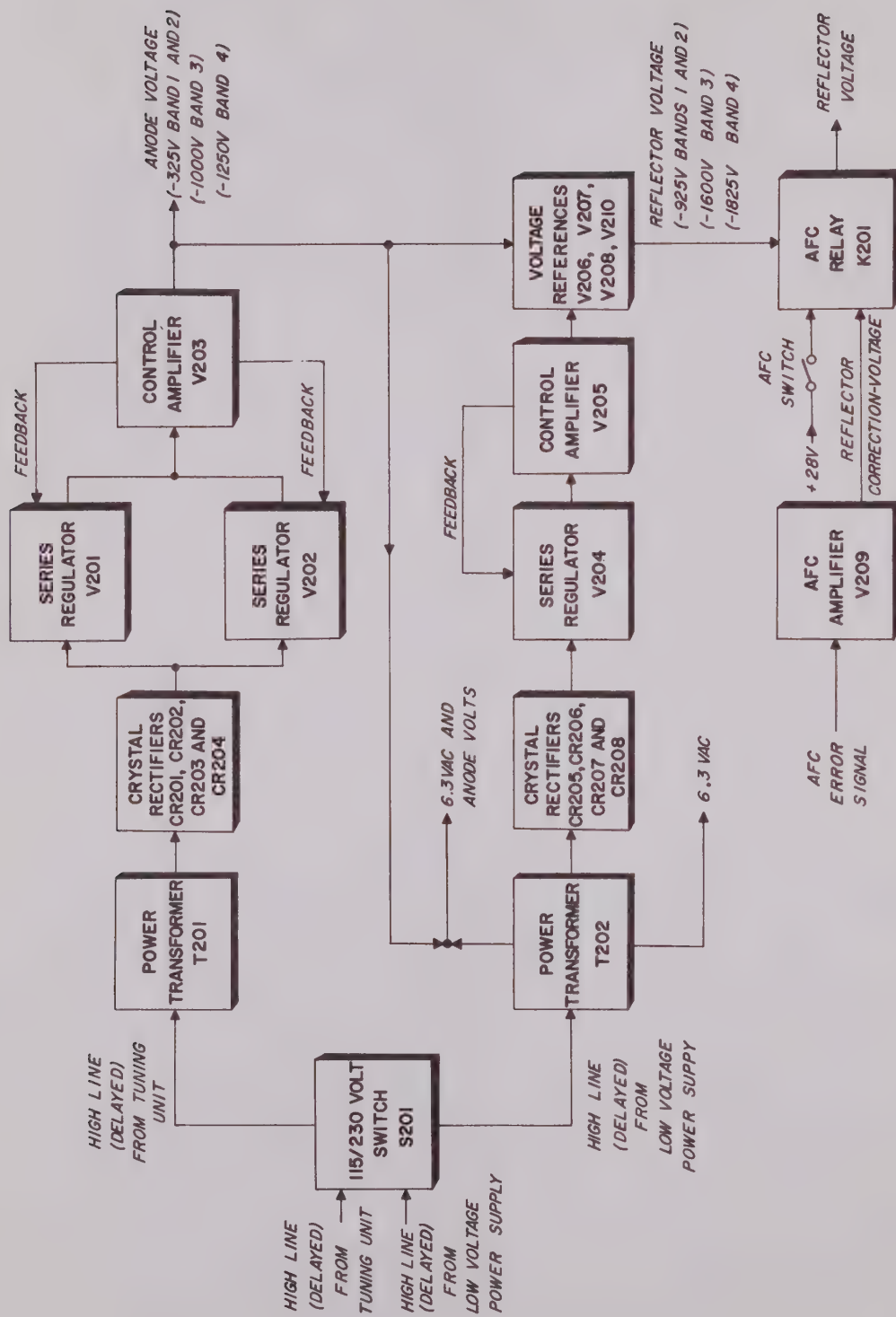


Figure 3-10. High-Voltage Power Supply, Functional Block Diagram

3-126. The bias on control amplifier V203 is adjusted by one of three controls, depending on which Tuning Unit is in use, as listed below in table 3-3, to such a value that the voltage appearing at the plate of V203 is the bias voltage for the control grids of series regulators V201 and V202 necessary to obtain the desired anode voltage across capacitor C209. Variations in the output of the anode supply due to fluctuations in the line voltage and/or load current requirements are amplified by control amplifier V203. The voltage change appearing at the plate of V203 adjusts the bias on series regulators V201 and V202, returning the output of the supply to the desired value.

TABLE 3-3. ANODE VOLTAGE ADJUSTMENT CONTROLS.

Tuning Unit	Proper Anode Voltage	Anode Voltage Adjust Control
FIM-L2	-325 volts	-325 Adj R216
FIM-S2	-325 volts	-325 Adj R216
FIM-M2	-1,000 volts	-1,000 Adj R214
FIM-X2	-1,250 volts	-1,250 Adj R213

3-127. -600-VOLT SUPPLY (REFLECTOR SUPPLY). The -600-volt (reflector) supply (see figures 3-10 and 5-7) is also a conventional series-type degenerative voltage regulator consisting of series regulator V204, control amplifier V205, and voltage references V206, V207, V208, and V210. The bias on the control grid of V205 is adjusted by Reflector Adj control R325 to that value which causes the voltage appearing across capacitor C210 to be -600 volts. Variations in power line voltage and/or load current requirements are amplified

by control amplifier V205. The voltage change appearing at the plate of V205 causes the grid bias voltage on series regulator V204 to change, correcting the output voltage.

3-128. The -600-volt (reflector) supply is connected in series with the anode supply to provide the reflector voltage required by the reflex klystrons of the Tuning Units. In this manner, both the anode and reflector voltages are automatically selected for the Tuning Unit in use. The proper reflector supply voltages for the Tuning Units are listed below in table 3-4.

TABLE 3-4. PROPER REFLECTOR SUPPLY VOLTAGES

Tuning Unit In Use	Proper Reflector Supply Voltage
Model FIM-L2	-925 volts
Model FIM-S2	-925 volts
Model FIM-M2	-1,600 volts
Model FIM-X2	-1,850 volts

3-129. EXTERNAL MODULATION CIRCUIT.

3-130. The applied square-wave modulating signal coupled to EXT MOD jack J302 is transformer coupled through T301 to the control grid of the signal calibrator. Crystal diode CR302 serves to prevent the grid of the signal calibrator from being driven too positive by the positive portion of the signal appearing at the secondary of T301.

3-131. In Basic Unit serial nos, 291, 294, 297, 298, 307 to 312, 315, 316, 321, and 322, the external modulation signal is applied to the control grid of the signal calibrator only when the FUNCTION SEL switch is set to ZERO SET. The signal then drives the reflex klystron, which is normally biased beyond cutoff, into the conducting region during the interval of the applied pulse.

SECTION IV
MAINTENANCE

4-1. INTRODUCTION.

4-2. This section contains maintenance and alignment procedures for the FIM-2. Included are a list of test equipment required, troubleshooting procedures for localizing the source of system malfunction to an individual subassembly or component, and the alignment procedures required to restore the FIM-2 to its original operating condition after the necessary repairs have been effected.

4-3. TEST EQUIPMENT REQUIRED.

4-4. The test equipment required for the maintenance and alignment of the FIM-2 system are listed in table 4-1.

4-5. PRELIMINARY INSPECTION.

4-6. Preliminary inspection is a series of visual and aural checks performed on the FIM-2 system while it is in an unenergized state in an effort to correct conditions which might eventually cause system failure. In general, these failures will be caused by the overheating of electrical components, the accumulation of dust, dirt, and/or other foreign matter on moving parts, and loose connectors and hardware.

4-7. REMOVAL OF FIM-2 FROM DUST COVER. To remove the FIM-2 from its dust cover, proceed as outlined in the following steps.

WARNING:

OPERATION OF THE FIM-2 INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. BE SURE TO REMOVE OPERATING POWER FROM THE BASIC UNIT BY DISCONNECTING ELECTRICAL POWER CABLE ASSEMBLY W1201 FROM POWER INPUT RECEPTACLE J100 BEFORE STARTING THE PRELIMINARY INSPECTION PROCEDURE.

TABLE 4-1. TEST EQUIPMENT REQUIRED.

EQUIPMENT, MODEL, AND MANUFACTURER	APPLICATION
Simpson Model 260 Multimeter	Checking voltage and resistance
Measurements Model 80 Standard Signal Generator	Checking i-f circuitry
Marconi Model TF1041B Vacuum Tube Voltmeter	Aligning i-f circuitry
Daven Model 640-50 R-f Attenuation Box	Checking r-f and i-f attenuator insertion loss
Telex Model MR-6 Headset	Tracking output meter scale
Polarad Model MK-1 Klystron Mode Alignment Modulator	Tracking first local oscillator and signal calibrator reflector voltage
Tektronix Model 513 Oscilloscope	Tracking first local oscillator and signal calibrator reflector voltage
FXR Models N410A, H410A, C410A, and W410A Frequency Meters	Tracking first local oscillator and signal calibrator reflector voltage
PRD Models 357, 356A, and 354B Waveguide-to-Coax Adapters (2 each)	Tracking first local oscillator and signal calibrator reflector voltage
Dage Model 1021H Crystal Detector	Tracking first local oscillator and signal calibrator reflector voltage
Polarad Models MSG-1, MSG-2A, and PMX Microwave Signal Generators	Aligning preselector
Polarad Model P-3 Microwave Power Meter	Checking signal calibrator power output
Polarad Model TM-1 Thermistor Mount	Checking signal calibrator power output

a. Turn each of the four captive-lock fasteners (one located at each corner at the rear of the dust cover) one-quarter turn counterclockwise with a screwdriver.

WARNING:

THE FIM-2 (WITH A PLUG-IN TUNING UNIT INSTALLED) WEIGHS APPROXIMATELY 200 POUNDS. TWO PEOPLE SHOULD BE EMPLOYED AT ALL TIMES WHEN LIFTING, TRANSPORTING, OR PACKING THE EQUIPMENT.

b. With two men working on the FIM-2 (one on each side of the equipment), grasp the two Tuning Unit front panel handles and carefully slide the Basic Unit and Tuning Unit from the dust cover.

4-8. REMOVAL OF TUNING UNIT FROM BASIC UNIT. To remove the Tuning Unit from the Basic Unit, proceed as outlined in the following steps.

a. Turn each of the four captive-lock fasteners (one located at each corner of the Tuning Unit front panel) one-quarter turn counterclockwise with a screwdriver.

CAUTION:

DO NOT REMOVE A TUNING UNIT FROM (OR INSERT A TUNING UNIT INTO) THE BASIC UNIT WHEN THE FREQUENCY IN KILOMEGACYCLES DIAL INDICATES A FREQUENCY OTHER THAN THE HIGH END OF THE BAND.

b. Note the FREQUENCY IN KILOMEGACYCLES dial indication. If an indication other than the high end of the band is obtained, rotate the TUNING control to obtain a FREQUENCY IN KILOMEGACYCLES dial indication at the high end of the band.

c. Grasp the two Tuning Unit front panel handles and carefully slide the Tuning Unit from the Basic Unit.

4-9. With the equipment now visible and accessible, proceed as outlined in table 4-2 in an effort toward finding evidence of conditions which might cause system failure.

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE.

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Cable assemblies (including electrical power cable, r-f cables, i-f cables, and video cables)	Kinks, cuts, deterioration, and fraying of insulation	Replace defective cable assembly	
	Loose connectors	Resolder connector or replace cable assembly	
	Dirt, oil, grease, and corrosion	Clean with a cloth moistened with cleaning solvent	
Harnessed cable assemblies	Loose connectors	Resolder connector	
	Deteriorated and/or frayed leads	Replace lead and relace cable	
	Defective or poor lacing	Relace cable	
Knobs, screws, connectors, and handles	Looseness	Tighten	Tighten carefully. Screws tightened beyond the pressure for which they were designed can be damaged or broken

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Front panel switches	Inability to change position	Replace and rewire switch	
	Looseness	Tighten mounting hardware	
	Bent or broken contacts	Straighten contacts with tweezer or replace and rewire switch	
Fuses	Dirty fuse clips	Clean with a cloth	
Frame assemblies and Basic Unit subassemblies	Dirt and rust	Remove with brush or low-pressure air	
	Oil and grease	Remove with a cloth moistened with cleaning solvent	
Mounting screws and clamps	Looseness	Tighten	Do NOT touch slotted shafts of variable resistors
Wiring	Loose wires	Resolder, recable, and reclamp	
	Frayed, worn, or missing insulation	Replace wire	

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Solder joints	Corroded joints	Clean and resolder	
Terminal board assemblies	Loose mounting	Tighten mounting screws and nuts	
Resistors	Cracks, chips, discoloration, blistering, and other signs of overheating	Replace resistor	Overheating components are a sign of equipment malfunction. Refer to proper troubleshooting paragraph to localize malfunction
Capacitors	Leaks, bulges, and other signs of deterioration	Replace capacitor	See above
Front panel meters	Bent pointer	Replace meter	
	Cracked or broken meter cover	Replace cover	
Vacuum tubes (except for reflex klystrons)	Poor seating	Press tubes firmly into sockets	Never work on tubes immediately after shutting off power. Do not jiggle or partially remove tubes from sockets. Such movements tend to weaken tube pins and spread socket connectors. DO NOT CHECK REFLEX KLYSTRONS

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Tube shields (except for reflex klystron protective shield)	Poor seating	Press into position	
	Missing shields	Replace	
Tube sockets	Cracked or chipped sockets	Replace and re-wire	
	Looseness	Tighten mounting screws	
FREQUENCY IN KILOMEGACYCLES dial window	Cracked or broken	Replace (A temporary repair may be effected with transparent tape)	
-DBM MICROVOLTS dial window	Cracked or broken	See above	
Precision mechanical drive system	Catching or jamming when TUNING control is rotated	Remove dust, dirt, and any foreign matter	Release the TUNING control Lock lever by turning it counterclockwise
	Broken gears	Replace	<u>CAUTION:</u> DO NOT MOVE THE PRECISION MECHANICAL DRIVE SYSTEM BY ANY MEANS OTHER THAN THE TUNING CONTROL. DO NOT INTERFERE IN ANY WAY WITH THE OPERATION OF THE GEARS WHILE THE TUNING CONTROL

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Precision mechanical drive system (cont'd)			IS BEING ROTATED. NEVER USE FORCE.
Thermistor probe and output attenuator probe drive system	Catching or jamming when either SIGNAL CALIBRATOR POWER SET or SIGNAL CALIBRATOR OUTPUT ATTENUATOR control is rotated	Remove dirt, dust, and any foreign matter	<u>CAUTION:</u> DO NOT MOVE THE DRIVE SYSTEM BY ANY MEANS OTHER THAN THE FRONT PANEL CONTROLS. DO NOT INTERFERE WITH THE OPERATION OF THE GEARS WHEN THE CONTROLS ARE BEING ROTATED. NEVER USE FORCE.
	Broken gears	Replace	

4-10. POWER SUPPLY CHECK.

4-11. Improper operation of the FIM-2 most likely will be caused by a malfunction of the power supplies located within the Basic Unit. The step-by-step troubleshooting procedure for localizing the malfunction to an individual section of the power supplies is listed in table 4-3. Further localization to an individual circuit component can be accomplished through the voltage and resistance measurements supplied in tables 4-4 and 4-5, the component location diagrams supplied in figures 4-1 through 4-8, and the schematic diagrams of the low-voltage and high-voltage power supplies supplied in figures 5-6 and 5-7, respectively. Make sure that all connectors are firmly secured to their mating receptacles before applying operating power to the FIM-2.

TABLE 4-3. POWER SUPPLY CHECK PROCEDURE

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
1	Visual and aural	None	Patch cable assembly W1206 connected between J1150 of Basic Unit and P1150 of Tuning Unit. POWER switch set to ON.	POWER pilot lamp immediately lights; blowers operate.	Proceed to step 5.	Check fuses F100 and F101. Check POWER pilot lamp assembly. Proceed to step 2.
2	Power source	A-c voltmeter	Measure source voltage.	115 volts rms.	Proceed to step 3.	Trouble is in a-c power source.
3	Electrical power cable assembly W1201	Ohmmeter	W1201 disconnected from both power source and Basic Unit Power Input receptacle J100.	Continuity from end to end for each lead. Infinite resistance between leads at either end.	Proceed to step 4.	Electrical power cable assembly W1201 defective; repair or replace as necessary.
4	Power Input receptacle J100	Ohmmeter	W1201 disconnected from J100. Measure resistance between pins of J100.	1 ohm.	Connect W1201 to J100.	Trouble lies in Power Input receptacle J100, line filters FL100 and/or FL101, POWER switch S303, 115/230V switch S201, blower B101, or the primaries of power transformers T103 and/or T104.
5	Visual	None	POWER switch set to ON.	KLY pilot lamp lights approximately 60 seconds after operating power is applied.	Proceed to step 9.	Check KLY pilot light assembly. Check fuse F104. Proceed to step 6.
6	Terminal board assembly TB102	D-c voltmeter	Voltmeter connected between junction of CR108 and CR111 and junction of CR109 and CR110.	+28 volts.	Proceed to step 7.	+28-volt supply defective.
7	Delay relay K100	D-c voltmeter	Voltmeter connected between pins 1 and 6 of K100.	0 volts.	Proceed to step 8.	Delay relay K100 defective; replace.
8	Hold relay K101	D-c voltmeter	Voltmeter connected between pins 2 and 9 of K101.	0 volts	-----	Hold relay K101 defective; replace.
9	Visual	None	OUTPUT switch set to ZERO SET. Adjust output meter ZERO SET control to obtain an output meter pointer deflection corresponding to zero-set.	Output meter pointer can be zero-set.	Proceed to step 13.	Check output meter ZERO SET control R310. Proceed to step 10.

TABLE 4-3. POWER SUPPLY CHECK PROCEDURE (cont'd).

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
10	Visual	None	Set Test Selector switch S351 to -140 V.	Power monitor meter pointer deflects to an indication within the green region of the scale.	Proceed to step 11.	-140-volt supply defective.
11	Meter Sensitivity control R351	Ohmmeter	P351 disconnected from J108. Ohmmeter connected between pins A and B of P351.	Ohmmeter reads approximately 2.3K ohms	Reconnect P351 to J108. Proceed to step 12.	Meter Sensitivity control R351 defective: replace.
12	Output Meter M301	None	Check Meter.	-----	-----	Output Meter M301 defective replace.
13	Visual	None	FUNCTION SEL switch set to ZERO set. Adjust power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.	Power monitor meter can be zero-set.	Proceed to step 15.	Check power monitor meter ZERO SET control R312. Proceed to step 14.
14	Visual	None	Set Test Selector switch S351 to +105V.	Power monitor meter pointer deflects to an indication within the green region of the scale.	Check thermistor bridge circuitry (refer to paragraph 4-69).	+105-volt supply defective.
15	Visual	None	Set Test Selector switch S351 to Xtal Cur. Set FUNCTION SEL switch to OPERATE. Rotate TUNING control throughout the band	Power monitor meter pointer deflects smoothly (except at point of mode switching for the Models FIM-S2 and FIM-M2 Tuning Units) as the TUNING control is rotated.	Proceed to step 16.	First crystal mixer defective (refer to paragraph 4-59).
16	Visual	None	Set Test Selector switch S351 to Refl.	Power monitor meter pointer Deflects to an indication within the green region of the scale.	Proceed to step 17.	Adjust Refl. Adjust control to obtain a power monitor pointer deflection within the green region of the scale. <u>NOTE:</u> Adjustment of Refl Adjust control R235 to obtain indication of proper reflector voltage will necessitate retracking of first local oscillator and signal calibrator reflector voltage (refer to paragraph 4-70 and 4-88, respectively)

TABLE 4-3. POWER SUPPLY CHECK PROCEDURE (CONT'D)

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
16 (Cont)						and retracking of the preselector (refer to paragraph 4-92).
17	Visual	None	Test Selector switch set to Anode V.	Power monitor meter pointer deflects to indication within green region of scale.	Proceed to step 18.	Adjust proper anode voltage adjust control to obtain desired indication. If this cannot be obtained, anode supply is defective.
18	Visual	None	Test Selector switch set to Anode MA. FUNCTION SEL switch set to OPERATE.	Power monitor meter pointer deflects to indication of +1 (for FIM-L2 and FIM-S2) or -1 (for FIM-M2 and FIM-X2).	Proceed to step 19.	Adjust proper L.O. Bias control to obtain desired indication. If this cannot be obtained check first local oscillator grid bias resistors.
19	Visual	None	Test Selector switch set to Anode Ma. FUNCTION SEL switch set to CAL SIG GEN.	Same as above.	Proceed to step 20.	Adjust proper S.C. Bias control to obtain desired deflection. If this cannot be obtained check signal calibrator grid bias resistors.
20	Visual	None	Test Selector switch set to +130V	Power monitor meter pointer deflects to indication within green region of scale.	Basic Unit power supplies operating properly. Proceed to paragraph 4-12.	Adjust +130V Adj control R114 to obtain desired indication. If this cannot be obtained +130 volt supply defective.

TABLE 4-4. LOW-VOLTAGE POWER SUPPLY,
VOLTAGE AND RESISTANCE MEASUREMENTS

Socket	Tube Type	Pin Numbers								
		1	2	3	4	5	6	7	8	
XV100	6AS7	+87	+235	+125	+87	+235	+125	FIL	FIL	Volts
		550K	8.5K	8.2K	550K	8.5K	8K	Inf	Inf	Ohms
XV101	6AS7	+87	+235	+125	+87	+235	+125	FIL	FIL	Volts
		550K	8.5K	8.2K	550K	8.5K	8K	Inf	Inf	Ohms
XV102	6AU6	-1	0	FIL	FIL	+75	+33	0		Volts
		550K	0	Inf	Inf	550K	30K	0		Ohms
XV104	0B2	+105	0	NC	0	+105	NC	0		Volts
		Inf	0		0	Inf		0		Ohms
Socket	Transistor Type	Emitter		Collector		Base				
XTR100	2N277	-7.5		-11		-8				Volts
		0.5		9		10				Ohms
XTR101	2N277	-7.5		-11		-8				Volts
		0.5		9		10				Ohms
XTR102	2N456	-8		-11		-8.2				Volts
		10		9		15				Ohms
XTR103	2N207	-6		-8.2		-6.2				Volts
		14		15		0.8				Ohms

- NOTES: 1. FIL = 6.3 VAC between pins so marked.
2. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
3. Resistance readings taken with power cable removed.

TABLE 4-5. HIGH-VOLTAGE POWER SUPPLY, VOLTAGE AND RESISTANCE MEASUREMENTS.

Socket	Tube Type	Pin Number								
		1	2	3	4	5	6	7	8	9
XV201 4	807	Fil Inf	+125 280K	-5.2 500K	+2.6 50	Fil Inf	+530 8 Inf			Volts Ohms
XV201 5	807	Fil Inf	+125 280K	-9 500K	+1.3 50	Fil Inf	+575 8 Inf			Volts Ohms
XV201 6	807	Fil Inf	+125 320K	-5.8 600K	+2.4 50	Fil Inf	+520 8 Inf			Volts Ohms
XV202 4	807	Fil Inf	+125 280K	-5.2 500K	+2.6 50	Fil Inf	+530 8 Inf			Volts Ohms
XV202 5	807	Fil Inf	+125 280K	-9 500K	+1.3 50	Fil Inf	+575 8 Inf			Volts Ohms
XV202 6	807	Fil Inf	+125 320K	-5.8 600K	+2.4 55	Fil Inf	+520 8 Inf			Volts Ohms
XV203 4	12AX7	-5.2 500K	-57 250K	-56 22K		Fil Inf	-56 250K	-140 600K	-138 18K	Fil Inf
XV203 5	12AX7	-9.5 500K	-57 250K	-56 22K		Fil Inf	-56 250K	-140 620K	-138 18K	Fil Inf
XV203 6	12AX7	-5.7 600K	-57 260K	-53 22K		Fil Inf	-53 260K	-140 550K	-138 18K	Fil Inf
XV204 4	6AR6	-385 35K	NC	-118 Inf	NC	-118 Inf	Fil Inf	-385 550K	Fil Inf	Volts Ohms
XV204 5	6AR6	-1000 72K	NC	-560 Inf	NC	-560 Inf	Fil Inf	-1050 560K	Fil Inf	Volts Ohms
XV204 6	6AR6	-1250 90K	NC	-820 Inf	NC	-820 Inf	Fil Inf	-1300 830K	Fil Inf	Volts Ohms
XV205 4	12AX7	-385 550K	-460 175K	-460 Inf		Fil Inf	-460 175K	-610 600K	-100K	Fil Inf
XV205 5	12AX7	-1050 560K	-1100 210K	-1100 Inf		Fil Inf	-1100 210K	-1250 620K	-1250 135K	Fil Inf
XV205 6	12AX7	-1300 680K	-1380 240K	-1380 Inf		Fil Inf	-1380 240K	-1520 750K	-1520 160K	Fil Inf
XV206 4	OA2	-320 35K	-460 Inf	NC	-460 Inf	-320 35K	NC	-460 Inf		Volts Ohms
XV206 5	OA2	-980 72K	-1100 Inf	NC	-1100 Inf	-980 72K	NC	-1100 Inf		Volts Ohms
XV206 6	OA2	-1250 90K	-1380 Inf	NC	-1380 Inf	-1250 90K	NC	-1350 Inf		Volts Ohms
XV207 4	OB2	-910 80K	-1050 Inf	NC	-1050 Inf	-910 80K	NC	-1050 Inf		Volts Ohms
XV207 5	OB2	-1550 110K	-1700 Inf	NC	-1700 Inf	-1550 110K	NC	-1700 Inf		Volts Ohms
XV207 6	OB2	-1800 135K	-1960 Inf	NC	-1960 Inf	-1800 135K	NC	-1960 Inf		Volts Ohms
XV208 4	OA2	-1050 Inf	-1150 Inf	NC	-1150 Inf	-1050 Inf	NC	-1150 Inf		Volts Ohms
XV208 5	OA2	-1700 Inf	-1780 Inf	NC	-1780 Inf	-1700 Inf	NC	-1780 Inf		Volts Ohms
XV208 6	OA2	-1960 Inf	-2050 Inf	NC	-2050 Inf	-1960 Inf	NC	-2050 Inf		Volts Ohms
XV209 4	6AH6	0 Inf	0 Inf	Fil Inf	Fil 9 0	0 Inf	-910 30K	Fil 9 Inf		Volts Ohms
XV209 5	6AH6	0 Inf	0 Inf	Fil Inf	Fil 9 0	0 Inf	-1550 110K	Fil 9 Inf		Volts Ohms
XV209 6	6AH6	0 Inf	0 Inf	Fil Inf	Fil 9 0	0 Inf	-1800 135K	Fil 9 Inf		Volts Ohms
XV210 4	OA2	-460 Inf	-610 100K	NC	-610 100K	-460 Inf	NC	-610 100K		Volts Ohms
XV210 5	OA2	-1100 Inf	-1250 135K	NC	-1250 135K	-1100 Inf	NC	-1250 135K		Volts Ohms
XV210 6	OA2	-1380 Inf	-1520 160K	NC	-1520 160K	-1380 Inf	NC	-1520 160K		Volts Ohms

NOTES:

1. FIL = 6.3 VAC between pins so marked
2. Voltage readings taken with 20,000 ohm/volt VOM between pin and ground.
3. Resistance readings taken with power cable removed.
4. FIM-L2 or FIM-S2 Tuning Unit in use.
5. FIM-M2 Tuning Unit in use.
6. FIM-X2 Tuning Unit in use.
7. AFC switch set to OUT.
8. Measured between tube cap and ground
9. Pin 4 shorted to pin 7.

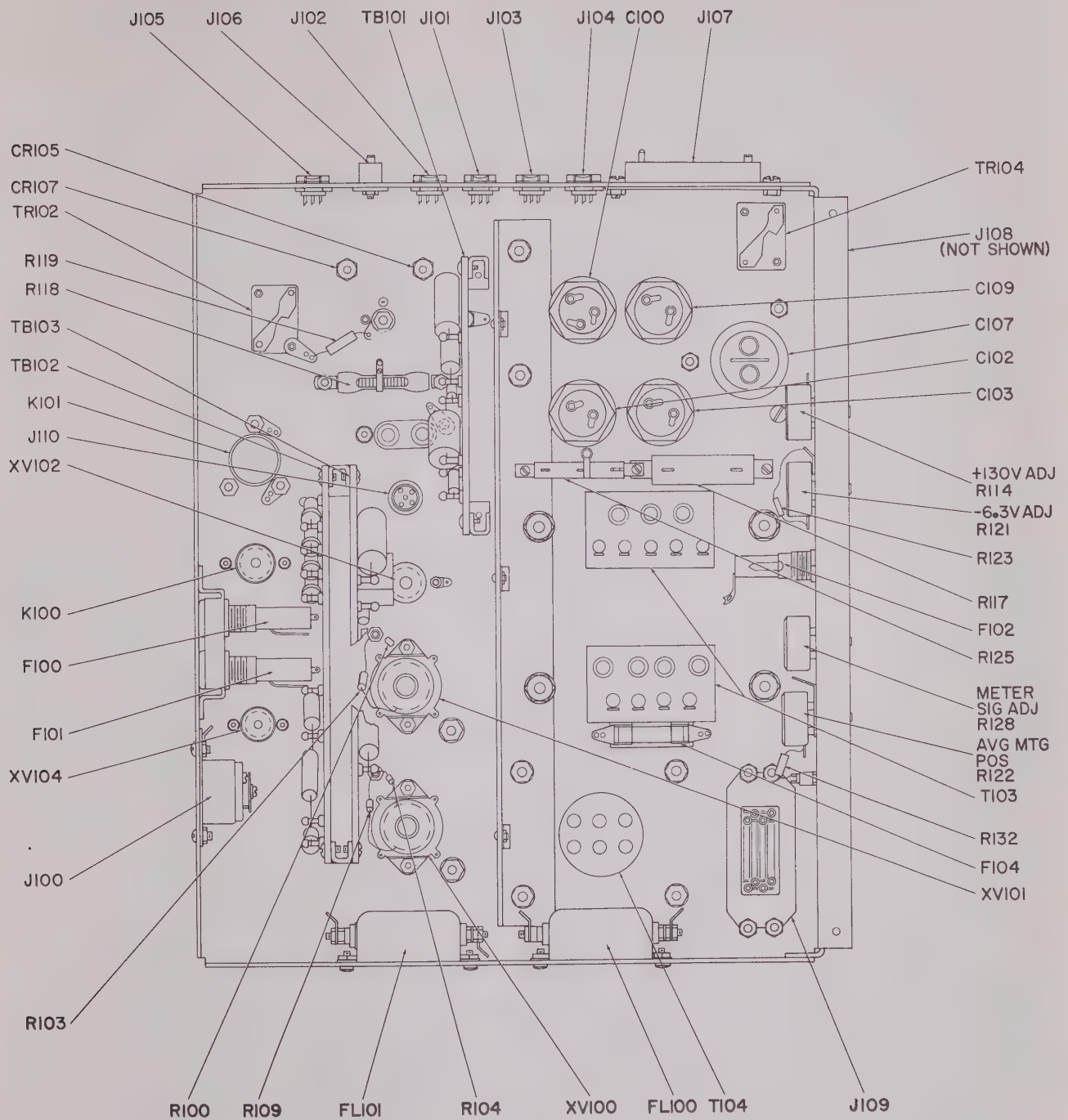


Figure 4-1. Low-Voltage Power Supply, Component Location Diagram

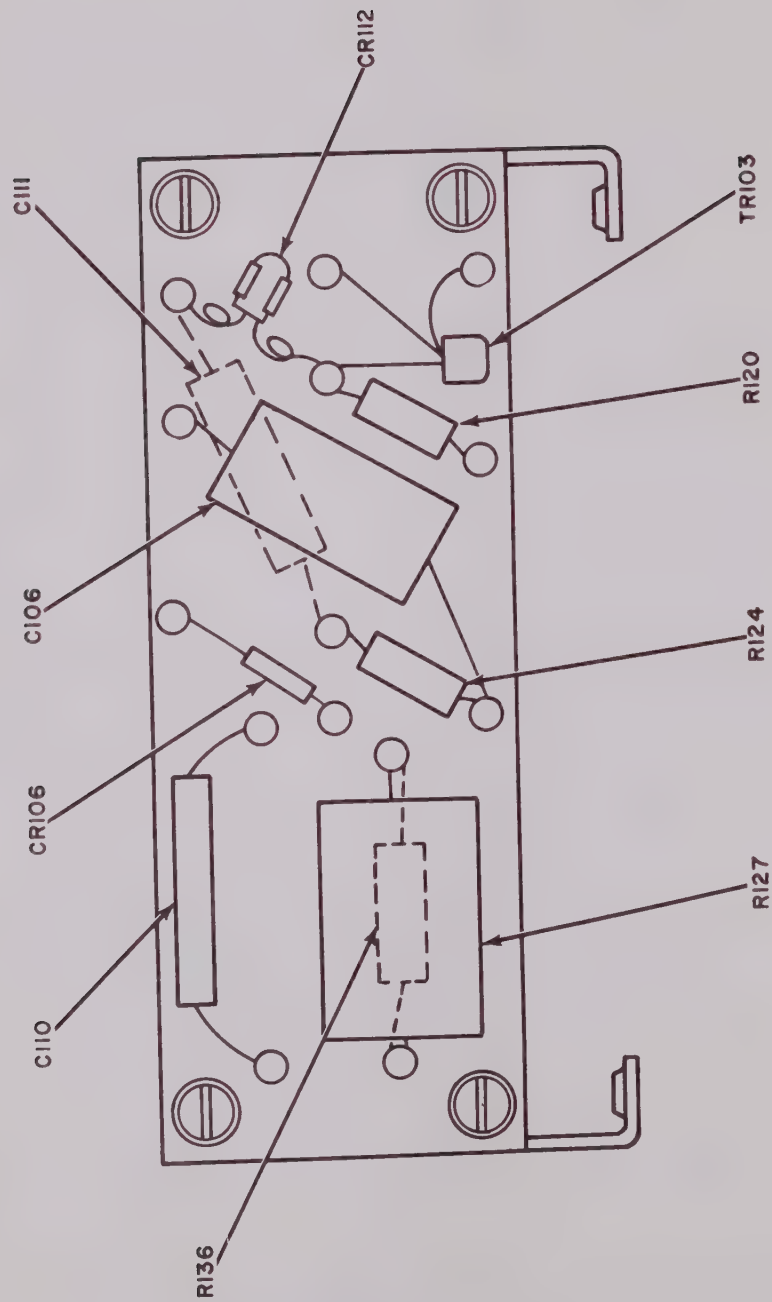


Figure 4-2. Terminal Board Assembly TBL01, Component Location Diagram

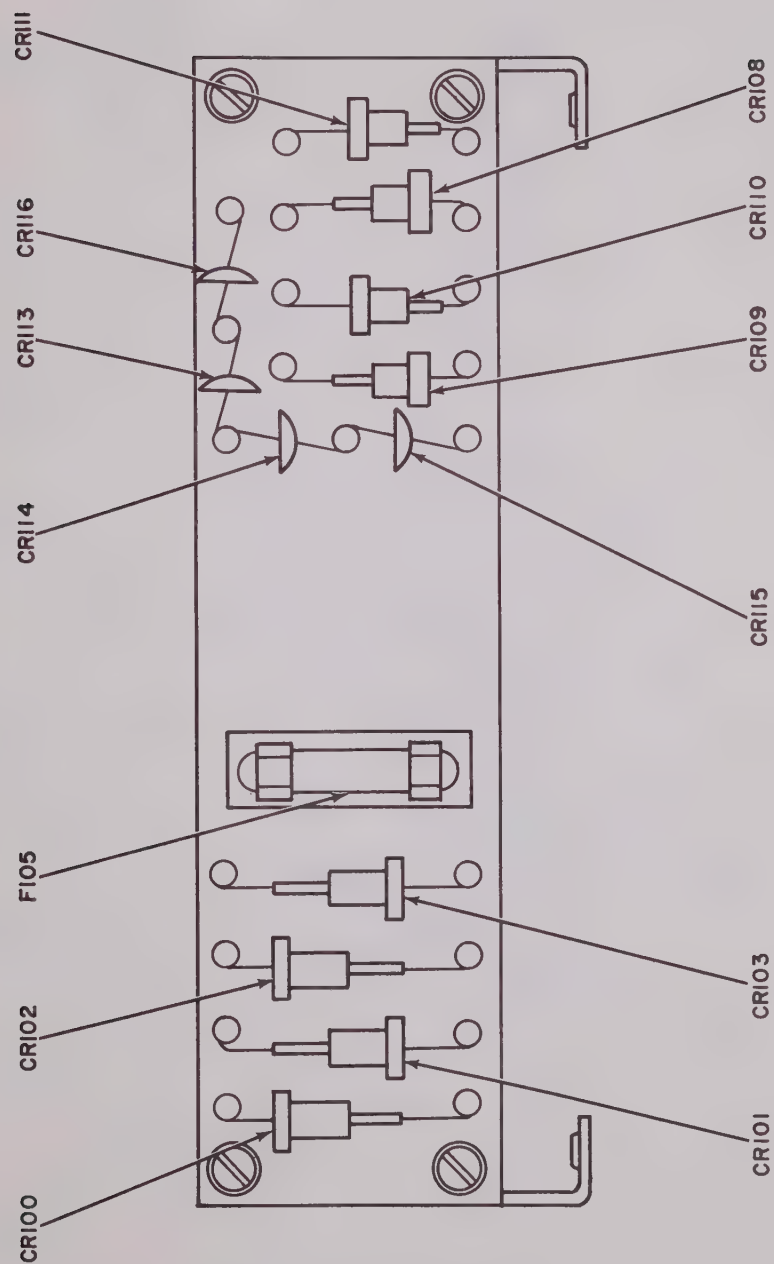


Figure 4-3. Terminal Board Assembly TBl02, Component Location Diagram

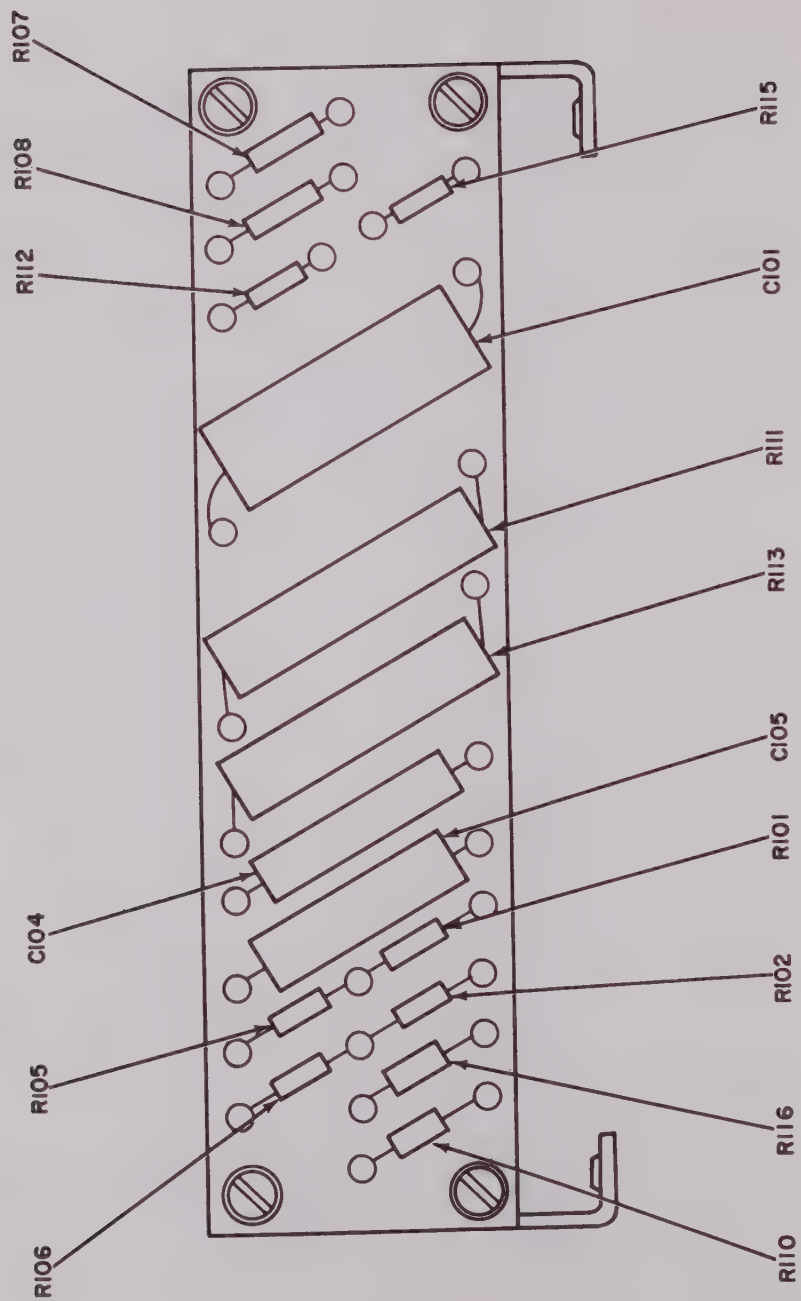


Figure 4-4. Terminal Board Assembly TB103, Component Location Diagram

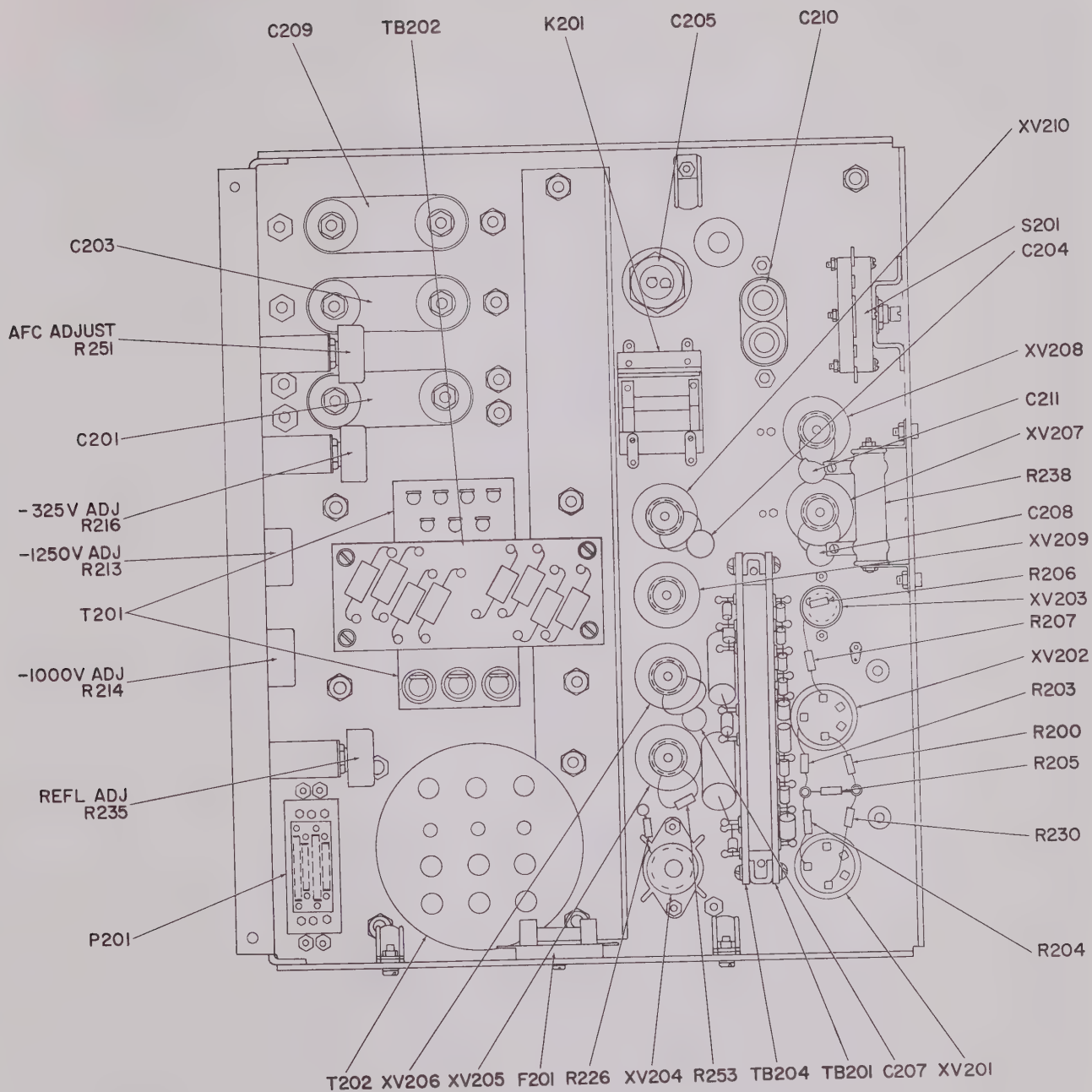


Figure 4-5. High-Voltage Power Supply, Component Location Diagram

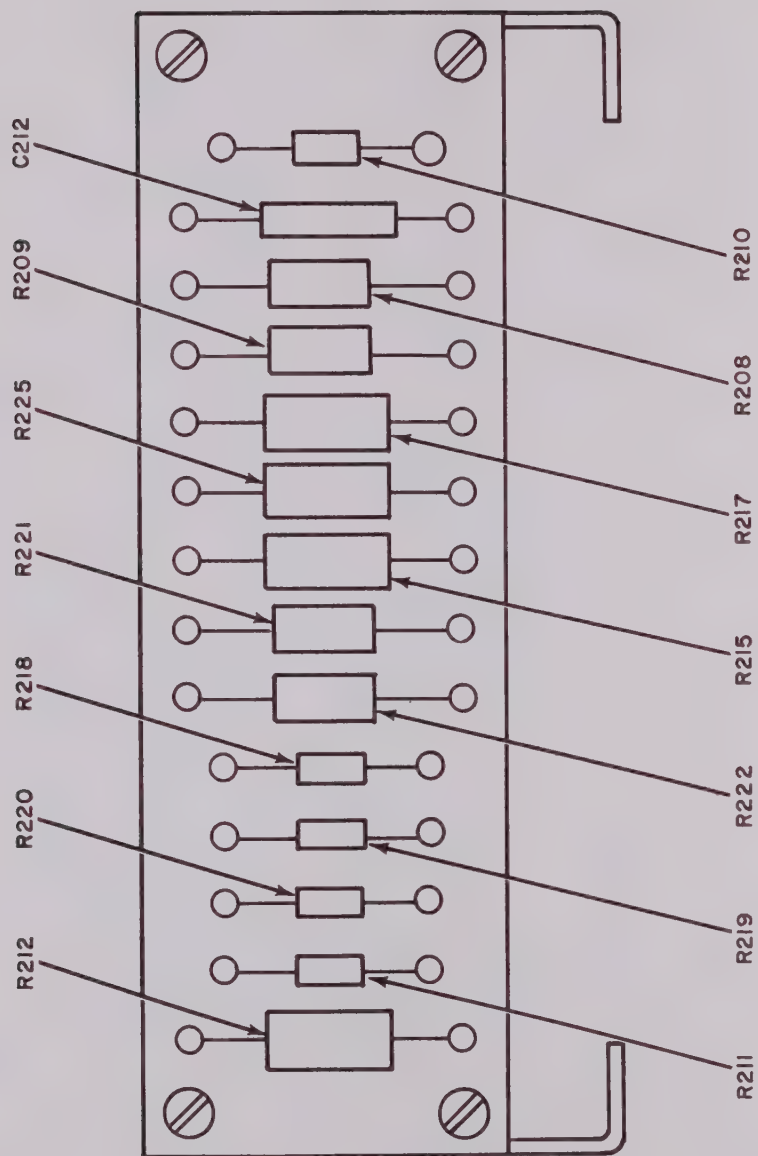


Figure 4-6. Terminal Board Assembly TB201, Component Location Diagram

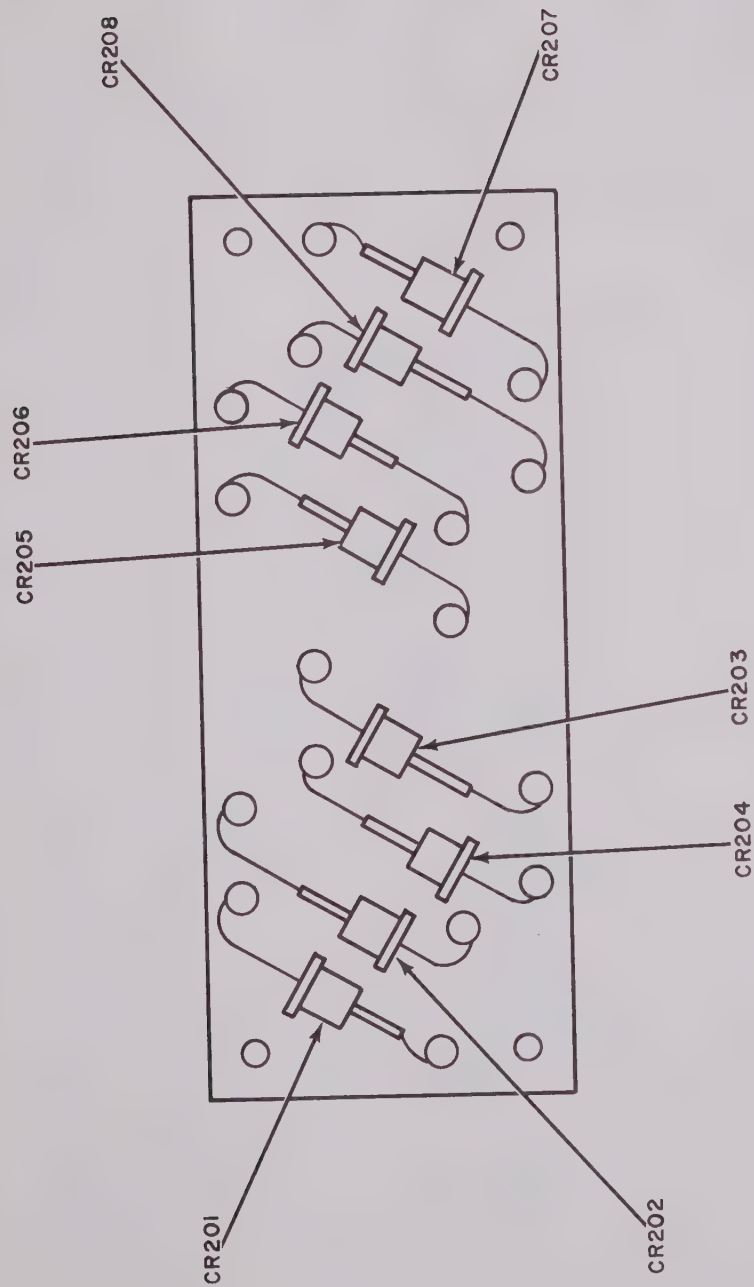


Figure 4-7. Terminal Board Assembly TB202, Component Location Diagram

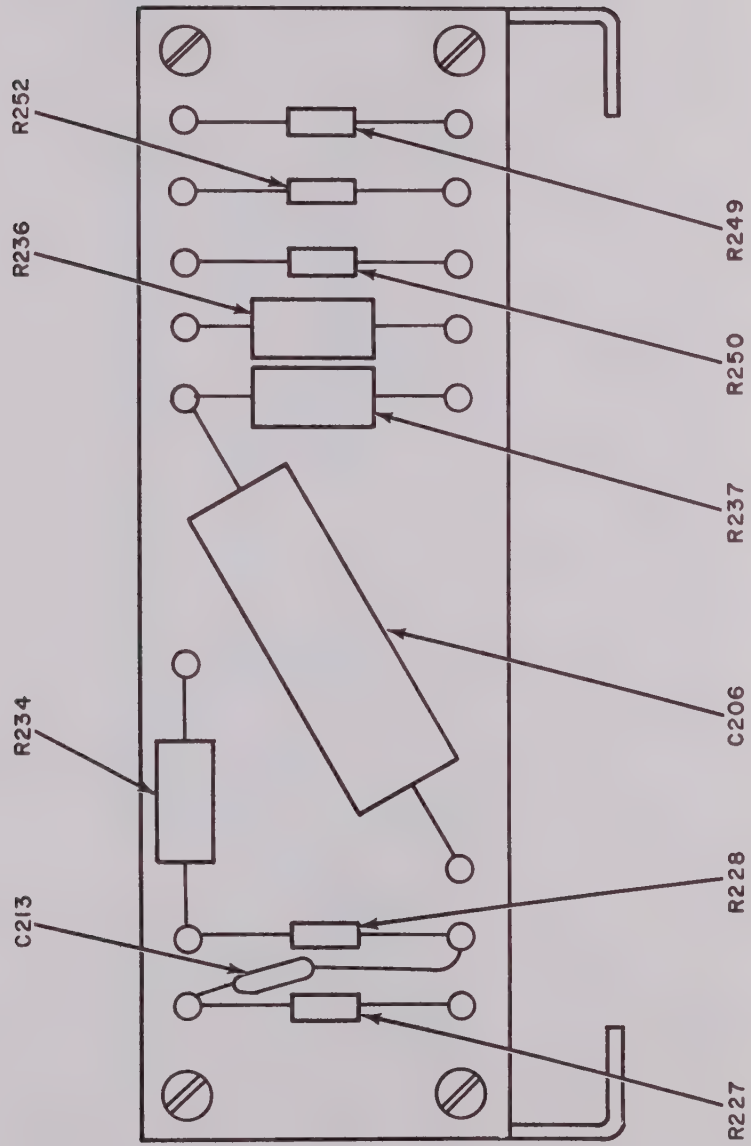


Figure 4-8. Terminal Board Assembly TB204, Component Location Diagram

4-12. LOCALIZING TROUBLE TO EITHER R-F OR I-F CIRCUITRY.

4-13. After the power supplies have been checked out and are operating properly (see paragraph 4-10), proceed as outlined in the following steps to determine if the cause of system malfunction is localized to the r-f or i-f circuitry.

a. Set the OUTPUT switch to ZERO SET.

b. Adjust the output meter ZERO SET control to zero-set the output meter.

c. Set the OUTPUT switch to AVERAGE.

d. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.

e. Rotate the IF GAIN control fully clockwise.

f. Note the output meter pointer deflection on the RF UV scale. It should deflect to an indication of at least 30.

g. Connect a calibrated signal generator, tuned to 260 mc and adjusted to an output level of 3 microvolts, to the IF IN jack, as shown in figure 4-9.

h. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale.

i. Adjust the output level of the calibrated signal generator to 300 microvolts. Note the output meter pointer deflection. It should deflect to an indication of 1000 $\begin{smallmatrix} +60 \\ -56 \end{smallmatrix}$ on the RF UV scale.

j. If the output meter pointer deflections of steps f and i, above, cannot be obtained, the trouble has been localized to the i-f circuitry (refer to paragraph 4-14). If these indications are obtained, the trouble has been localized to the r-f circuitry (refer to paragraph 4-57).

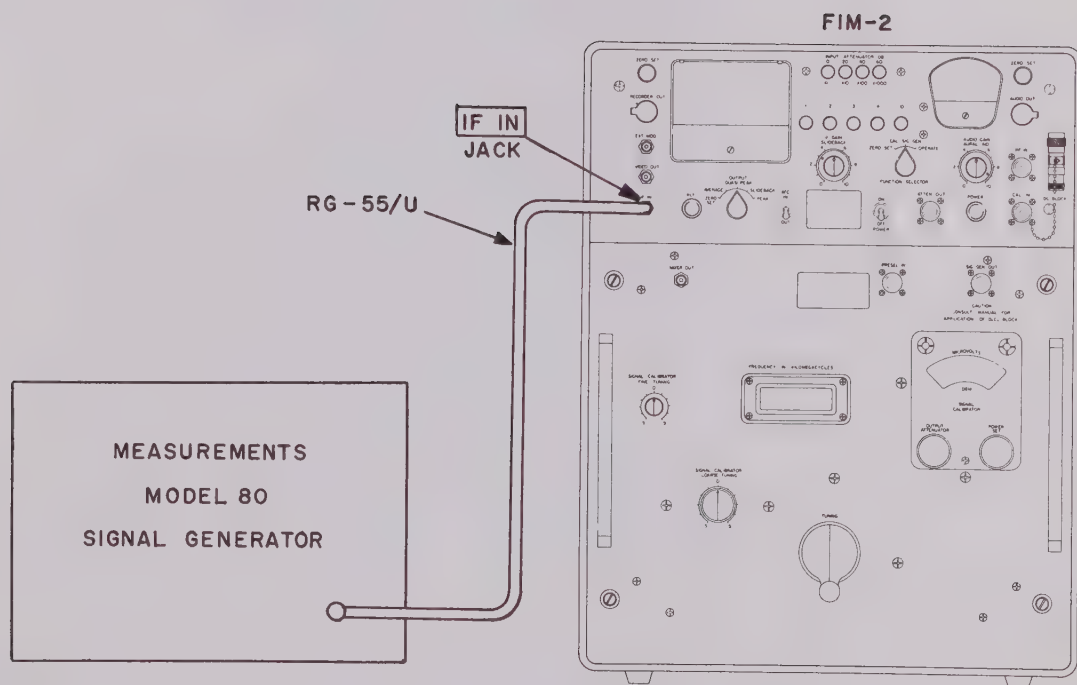


Figure 4-9. Localizing Trouble to Either R-f or I-f Circuitry, Equipment Set Up

4-14. LOCALIZING I-F TROUBLE TO AN INDIVIDUAL SUBASSEMBLY.

4-15. If the result of paragraph 4-12 indicated that the trouble lies in the i-f circuitry, proceed as outlined in table 4-6 to localize the i-f trouble to an individual subassembly within the Basic Unit i-f circuitry. Figures 4-10 and 4-11 will be of aid in locating the Basic Unit subassemblies and cable assemblies.

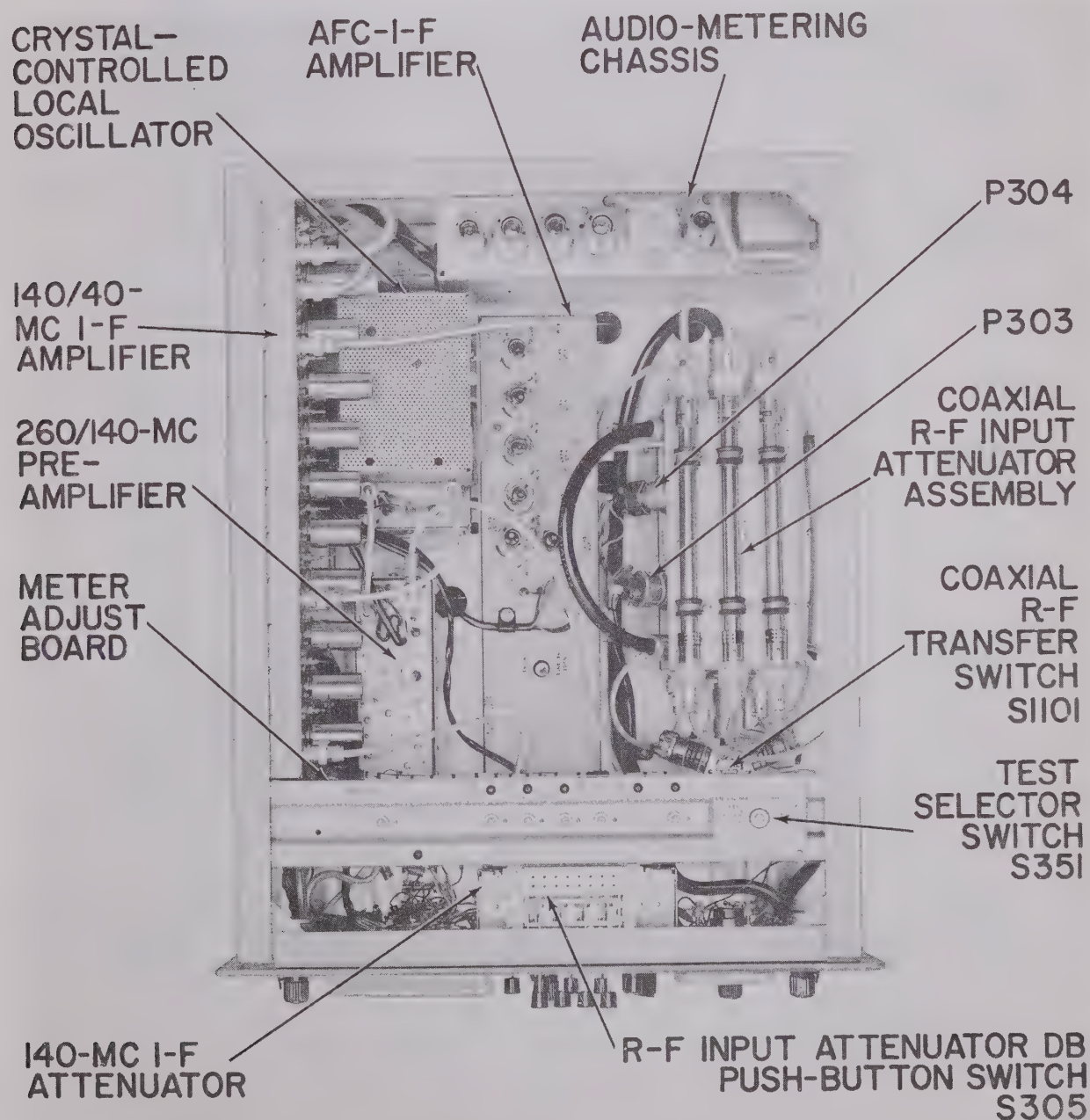


Figure 4-10. Basic Unit Subassembly Location Diagram

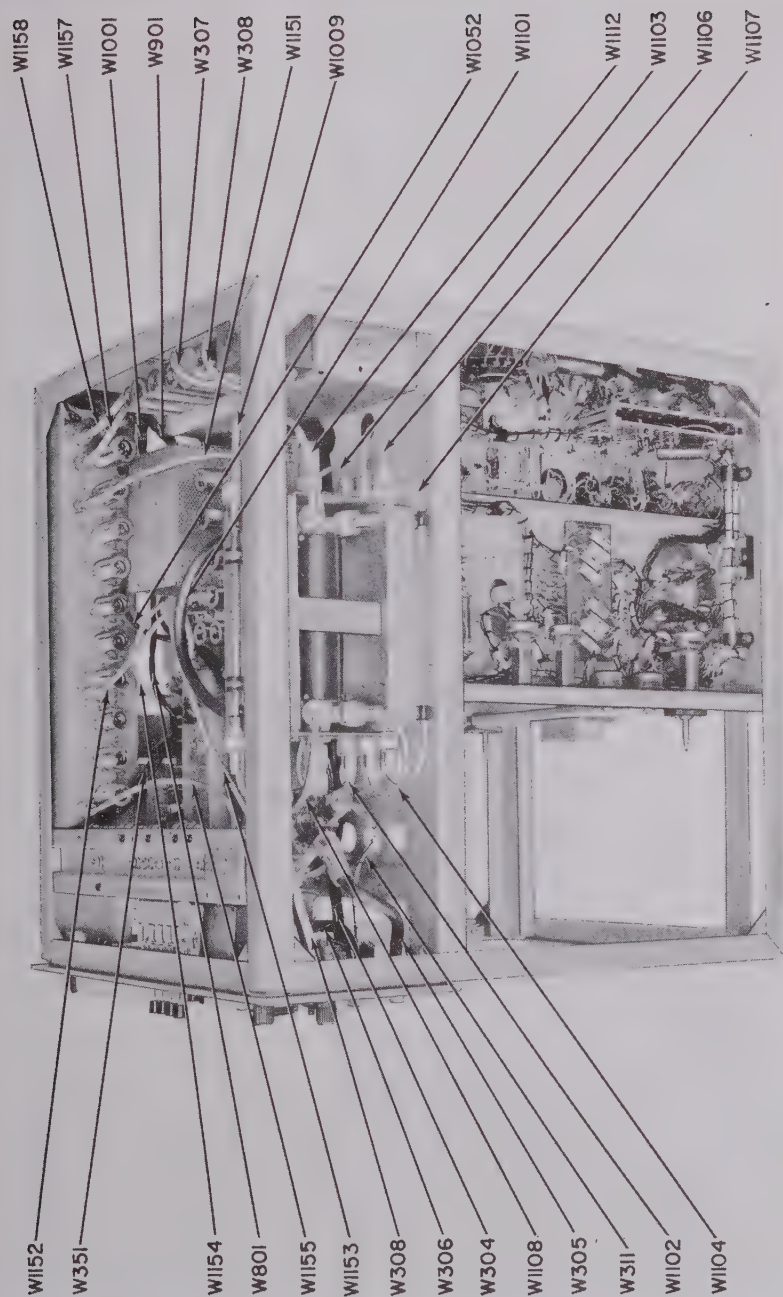


Figure 4-11. Basic Unit Interconnecting Cable Location Diagram
(Sheet 2 of 3)

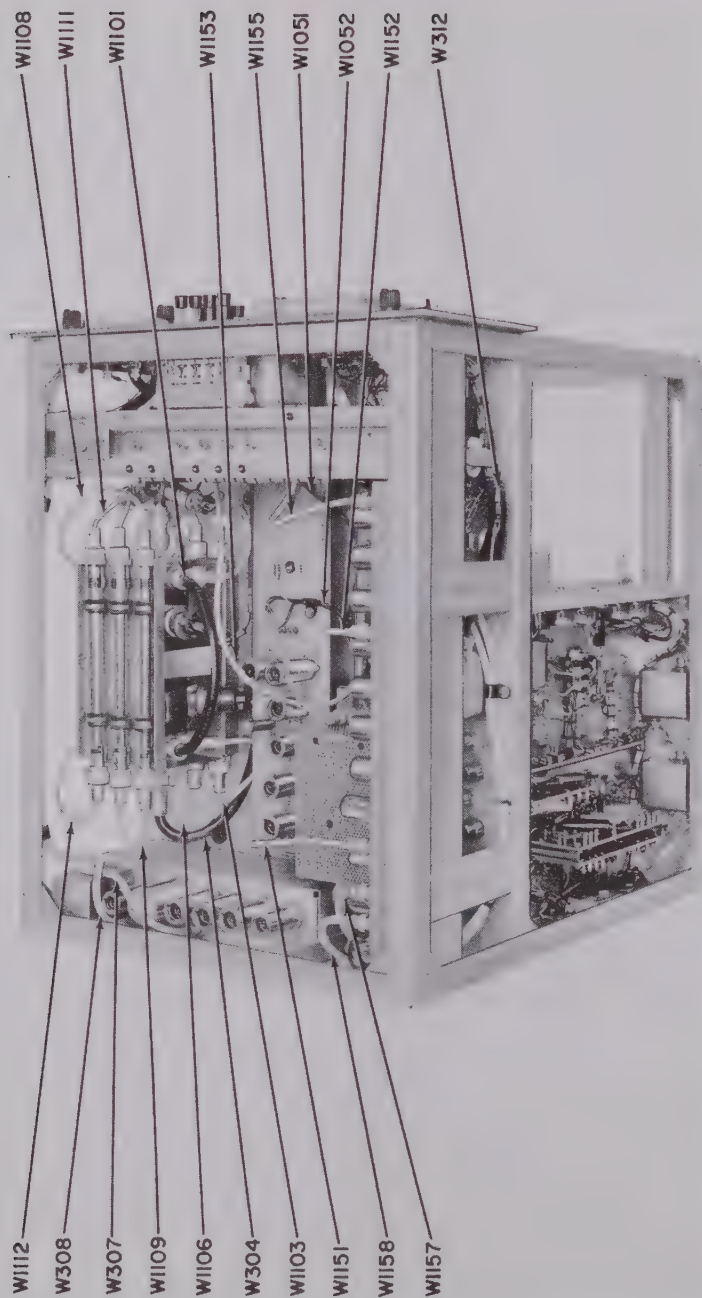


Figure 4-11. Basic Unit Interconnecting Cable Location Diagram
(Sheet 3 of 3)

TABLE 4-6. I-F TROUBLESHOOTING PROCEDURE.

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION NORMAL	IF INDICATION ABNORMAL
1	140-mc i-f attenuator input jack J326	Calibrated signal generator	Remove all i-f attenuation. Connect the signal generator to J326, as shown in figure 4-12, sheet 1. Tune the signal generator to 140 mc and adjust its output level to 4 microvolts. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale. Adjust the output level of the signal generator to 400 microvolts. Note the output meter pointer deflection	Output meter pointer deflects to an indication of 1000 (+60, -56) microvolts on the RF UV scale	Trouble lies in i-f cable assembly W1153, the 120-mc section of the crystal-controlled local oscillator, i-f cable assembly W1154, i-f cable assembly W303, or the 260/140-mc preamplifier. Proceed to step 2.	Trouble lies between the 140-mc i-f attenuator input jack and the output meter. Proceed to step 6.
2	I-f cable assembly W1153	Ohmmeter	W1153 disconnected from both 140-mc i-f attenuator input jack J326 and 260/140-mc preamplifier output jack J802.	Continuity from end to end of cable for both inner and outer conductors. Infinite resistance between inner and outer conductor at each end of cable	Trouble lies in 120-mc section of crystal-controlled local oscillator, i-f cable W1154, i-f cable W303, or 260/140-mc preamplifier. Proceed to step 3.	I-f cable assembly W1153 defective. Repair or replace as required.
3	Crystal-controlled local oscillator output jack J851	50-ohm detector (see figure 4-13) and vtvm	Rotate the AURAL AID control fully counterclockwise to its "off" position. Connect the vtvm, through the 50-ohm detector, to J851, as shown in figure 4-12, sheet 2.	Vtvm indicates between 1.3 and 1.5 volts.	Trouble lies in i-f cable assembly W1154, i-f cable assembly W303, or 260/140-mc preamplifier. Proceed to step 4.	120-mc section of crystal-controlled local oscillator defective. Refer to paragraph 4-16.
4	I-f cable assembly W1154	Ohmmeter	W1154 disconnected from both crystal-controlled local oscillator output jack J851 and 260/140-mc preamplifier input jack J803.	Same as step 2.	Trouble lies in i-f cable assembly W303 or 260/140-mc preamplifier. Proceed to step 5.	I-f cable assembly W1154 defective. Repair or replace as required.
5	I-f cable assembly W303 and IF IN jack J308	Ohmmeter	W303 disconnected from 260/140-mc preamplifier input jack J801.	Same as step 2.	Trouble lies in 260/140-mc preamplifier. Refer to paragraph 4-23.	I-f cable assembly W303 defective. Repair or replace as required.

TABLE 4-6. I-F TROUBLESHOOTING PROCEDURE (cont'd).

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION NORMAL	IF INDICATION ABNORMAL
6	140/40-mc i-f amplifier input jack J900.	Calibrated signal generator.	Connect the signal generator to J900, as shown in figure 4-12, sheet 3. Tune the signal generator to 140 mc and adjust its output level to 4 microvolts. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale. Adjust the output level of the signal generator to 400 microvolts. Note the output meter pointer deflection.	Same as step 1.	Trouble lies in i-f cable assembly W1155 or 140-mc i-f attenuator. Proceed to step 7.	Trouble lies between 140/40-mc i-f amplifier and output meter. Proceed to step 8.
7	I-f cable assembly W1155.	Ohmmeter.	W1155 disconnected from both 140-mc i-f attenuator output jack J325 and 140/40-mc i-f amplifier input jack J900.	Same as step 2.	Trouble lies in 140-mc i-f attenuator. Refer to paragraph 4-31.	I-f cable assembly W1155 defective. Repair or replace as required.
8	140/40-mc i-f amplifier output jack J902.	Calibrated signal generator, 50-ohm crystal detector (see figure 4-13), and vtvm.	Connect the signal generator to J900, as shown in figure 4-12, sheet 4. Tune the signal generator to 140 mc and adjust its output level to 4 microvolts. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale. Adjust the output level of the signal generator to 400 microvolts. Connect the vtvm, through the 50-ohm crystal detector to J902, as shown in figure 4-12, sheet 4. Note the vtvm indication.	Vtvm indicates between 0.7 and 0.8 volts.	Trouble lies between 140/40-mc i-f amplifier detectors and output meter. Proceed to step 11.	If signal is less, trouble lies in i-f cable assembly W1152, the 180-mc section of the crystal-controlled local oscillator, or the first eight stages of the 140/40-mc i-f amplifier. Proceed to step 9. If the signal is greater than 1 volt, the trouble lies between the weighting circuitry and the output meter. Proceed to paragraph 4-48.
9	I-f cable assembly W1152.	Ohmmeter	W1152 disconnected from both crystal-controlled local oscillator output jack J850 and 140/40-mc i-f amplifier input jack J901.	Same as step 2.	Trouble lies in 180-mc section of crystal-controlled local oscillator or first eight stages of the 140/40-mc i-f amplifier. Proceed to step 10.	I-f cable assembly W1152 defective. Repair or replace as required.

TABLE 4-6. I-F TROUBLESHOOTING PROCEDURE (cont'd).

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION NORMAL	IF INDICATION ABNORMAL
10	Crystal-controlled local oscillator output jack J850.	50-ohm crystal detector (see figure 4-13) and vtm.	Vtm connected to J850 through 50-ohm crystal detector, as shown in figure 4-12, sheet 5.	Vtm indicates between 1.0 and 1.5 volts.	Trouble lies in first eight stages of 140/40-mc i-f amplifier. Refer to paragraph 4-37.	180-mc section of crystal-controlled local oscillator defective. Refer to paragraph 4-16.
11	140/40-mc i-f amplifier output jack J903.	Calibrated signal generator, 10K resistor, and vtm.	Connect signal generator to J900, as shown in figure 4-12, sheet 6. Adjust output level of signal generator to 4 microvolts. Adjust IF GAIN control to obtain output meter pointer deflection of 10 on RF UV scale. Adjust output level of signal generator to 400 microvolts. Connect 10K resistor between J903 and chassis ground, as shown in figure 4-12, sheet 6. Connect vtm across 10K resistor.	Vtm indicates between -40 and -50 volts.	Trouble lies between video cable assembly W1157 and output meter. Proceed to step 12.	Trouble lies in last two stages of 140/40-mc i-f amplifier. Refer to paragraph 4-37.
12	Video cable assembly W1157.	Ohmmeter.	W1157 disconnected from J903.	Same as step 2.	Trouble lies in audio-metering chassis or weighting circuitry. Refer to paragraphs 4-46 or 4-48, respectively.	Video cable assembly W1157 defective. Repair or replace as required.
13	Afc-i-f amplifier output connector P1051.	Calibrated signal generator, vtm, 1-megohm resistor.	Calibrated signal generator connected to J1050, as shown in figure 4-12, sheet 7. Signal generator tuned to 38.25 mc and adjusted for an output level of 50,000 microvolts. Positive probe of vtm connected to pin B of P1051 through 1-megohm resistor, as shown in figure 4-12, sheet 7. Common probe of vtm connected to pin A of P1051. Note vtm indication. Adjust signal generator for 50,000 microvolts at 41.75 mc. Reverse vtm probes. Note vtm indication.	Vtm indicates approximately 3.5 volts in each position.	—	Afc-i-f amplifier defective. Refer to paragraph 4-52.

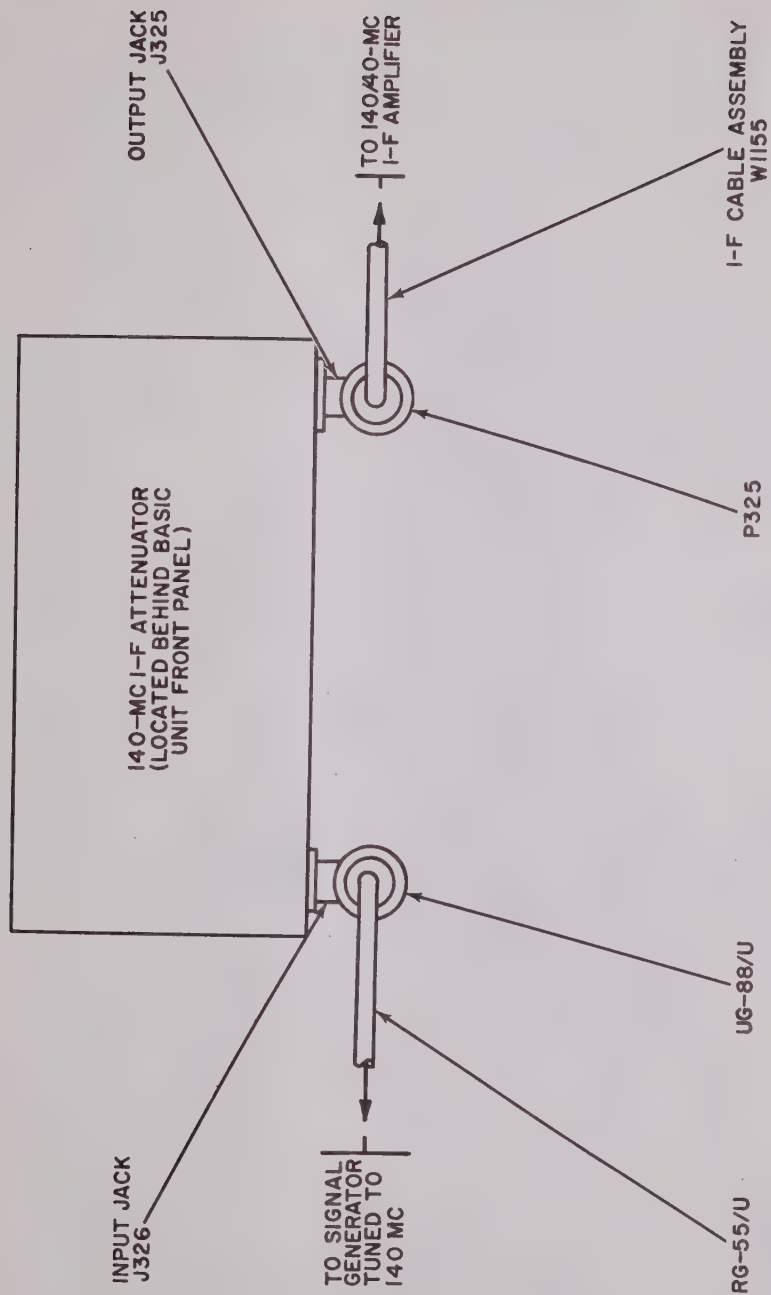


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up
(Sheet 1 of 7)

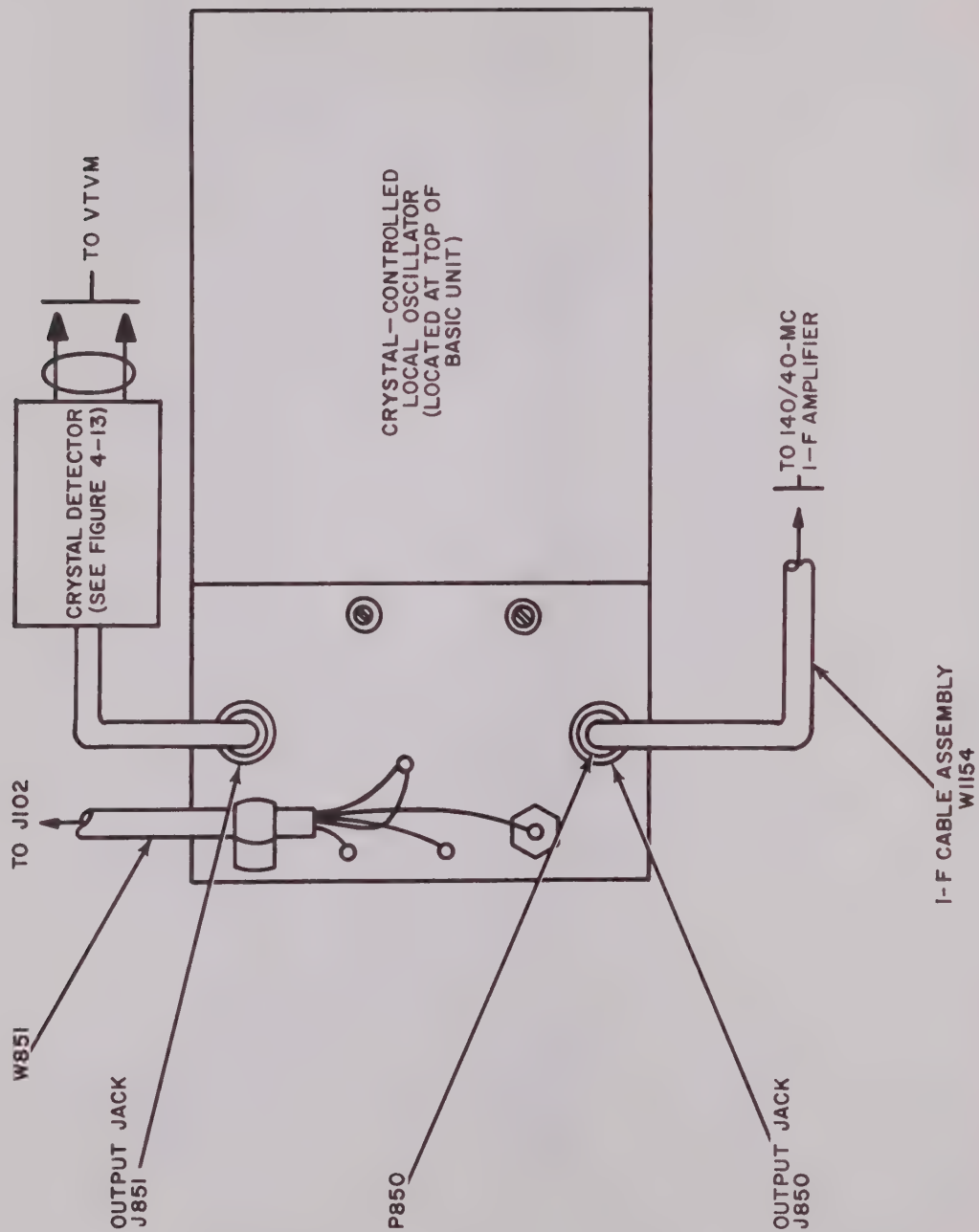


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up
(Sheet 2 of 7)

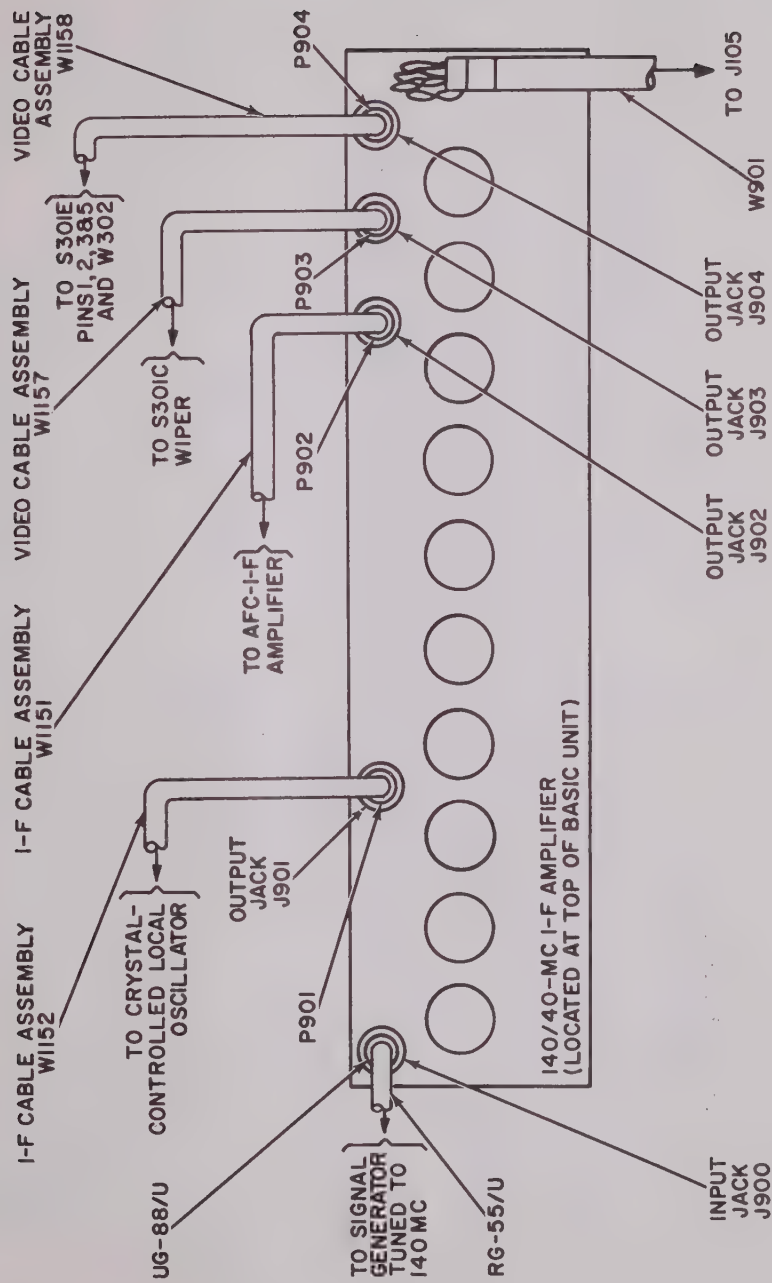


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up
(Sheet 3 of 7)

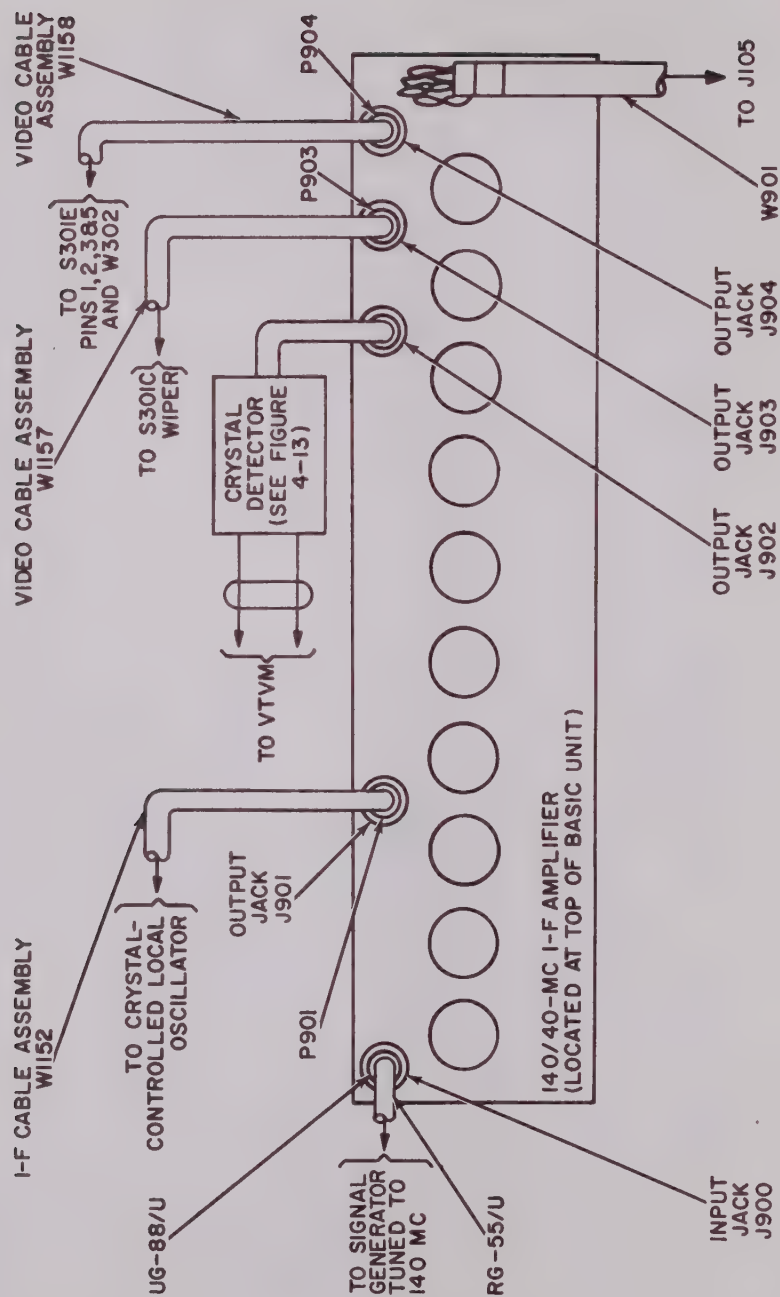


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up
(Sheet 4 of 7)

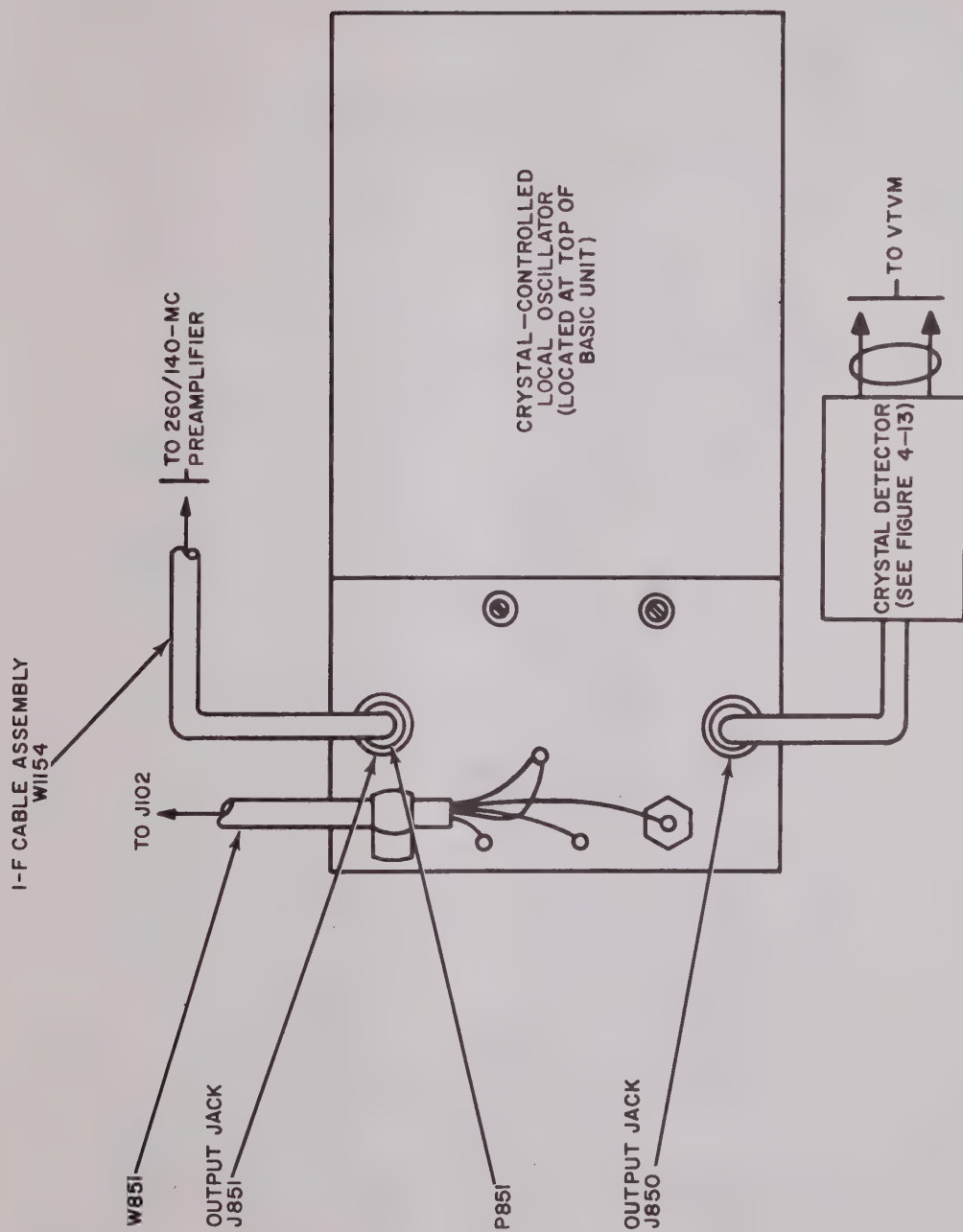


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up (Sheet 5 of 7)

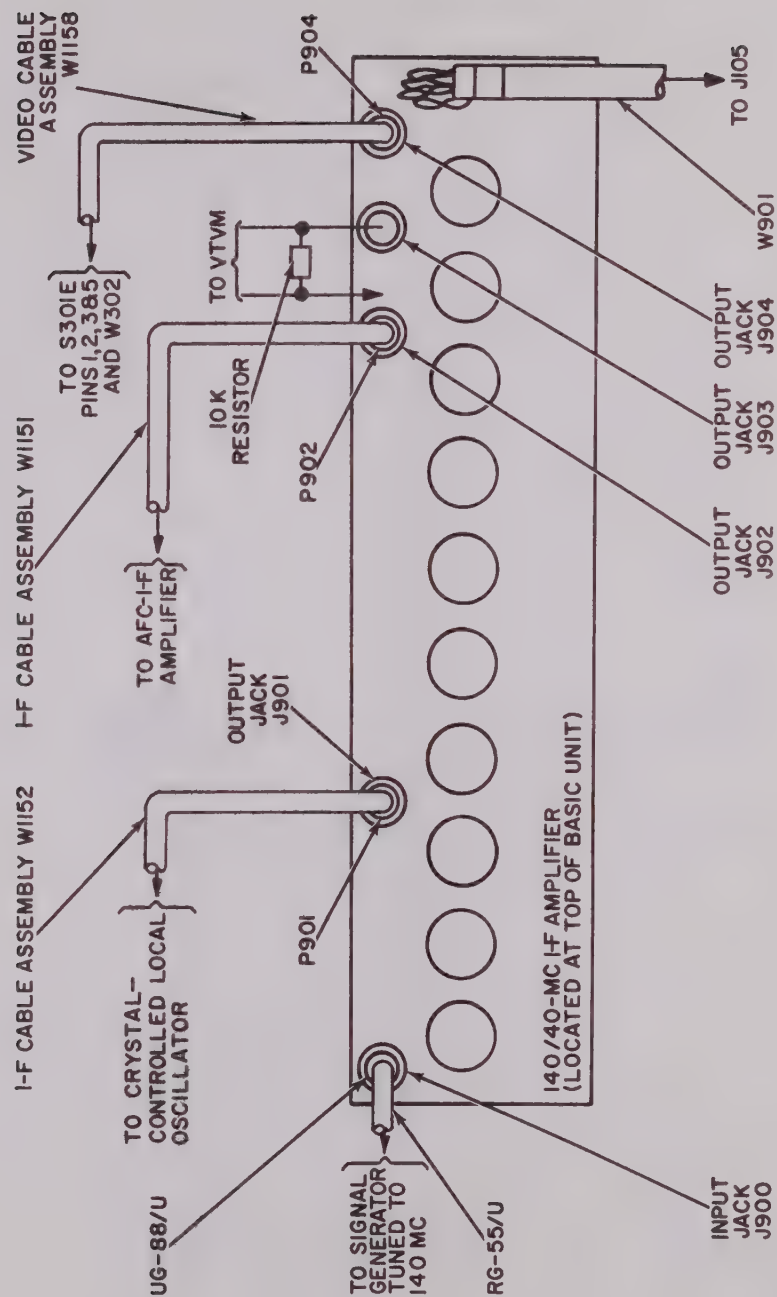


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up
(Sheet 6 of 7)

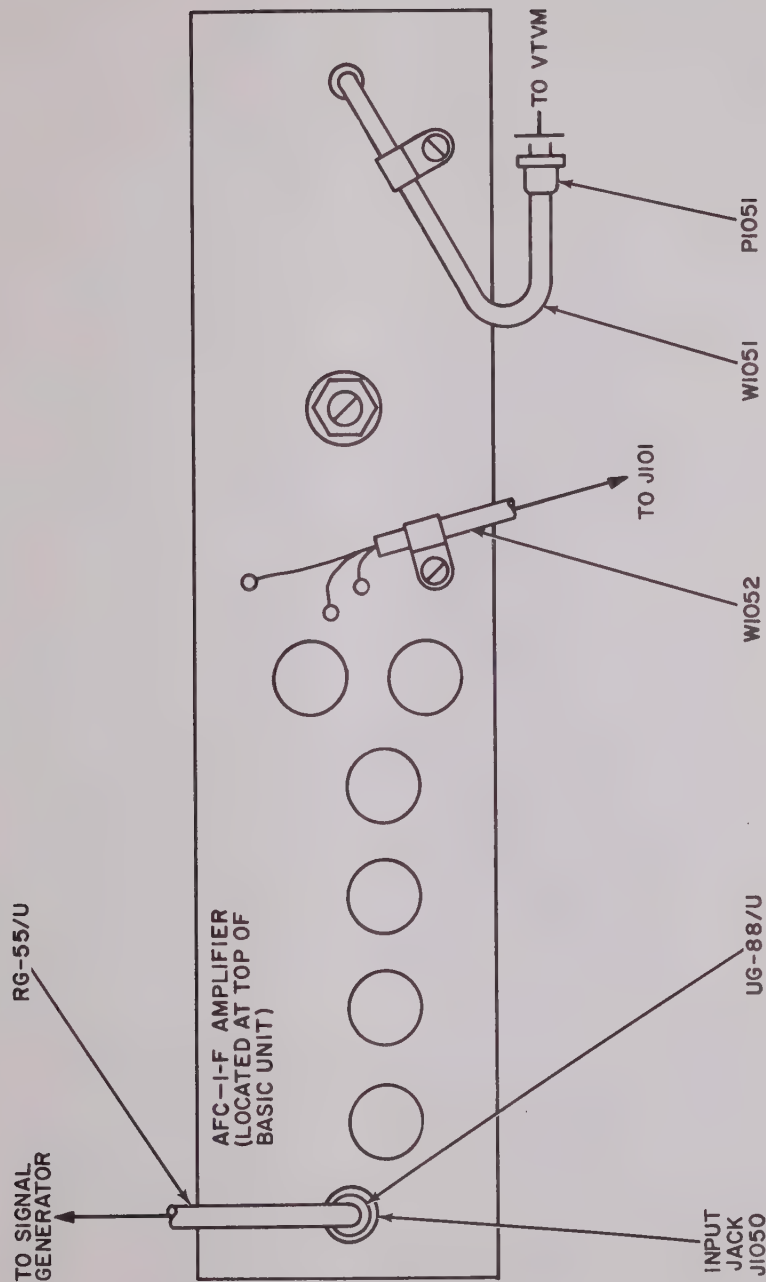


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up
(Sheet 7 of 7)

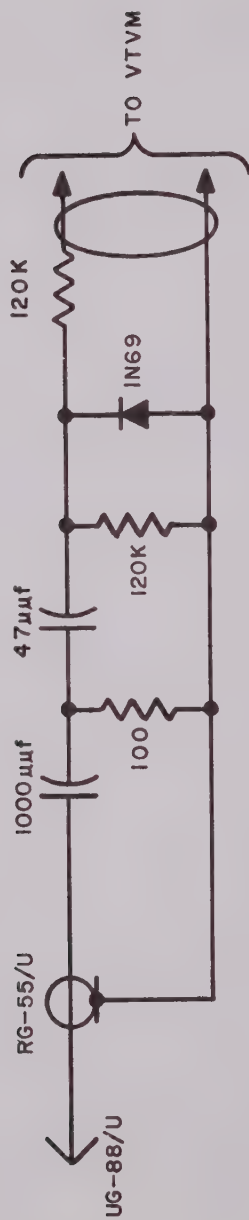


Figure 4-13. 50-ohm Crystal Detector, Schematic Diagram

4-16. CRYSTAL-CONTROLLED LOCAL OSCILLATOR, TROUBLESHOOTING.

4-17. To remove the crystal-controlled local oscillator subassembly from the Basic Unit frame for troubleshooting and effecting necessary repairs, proceed as outlined in the following steps.

a. Disconnect P850 from J850.

b. Disconnect P851 from J851.

c. Loosen and remove the four screws that secure the subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.

d. Remove the crystal-controlled local oscillator from the Basic Unit by disconnecting P852 from J102 and withdrawing the subassembly.

e. Loosen and remove the eight screws that secure the mounting plate and the shield to the subassembly. Again, place the screws and their associated hardware in an accessible location.

f. Remove the mounting plate and the shield from the crystal-controlled local oscillator subassembly. The individual components that constitute the chassis will now be visible and accessible.

4-18. A defect within the crystal-controlled local oscillator can be found by use of the component location diagram supplied in figure 4-14, the voltage and resistance measurements supplied in table 4-7, and the schematic diagram of the subassembly supplied in figure 5-5.

NOTE:

When making voltage and resistance measurements, be sure to connect P852 to J102, thereby coupling the crystal-controlled local oscillator to the remainder of the FIM-2 system.

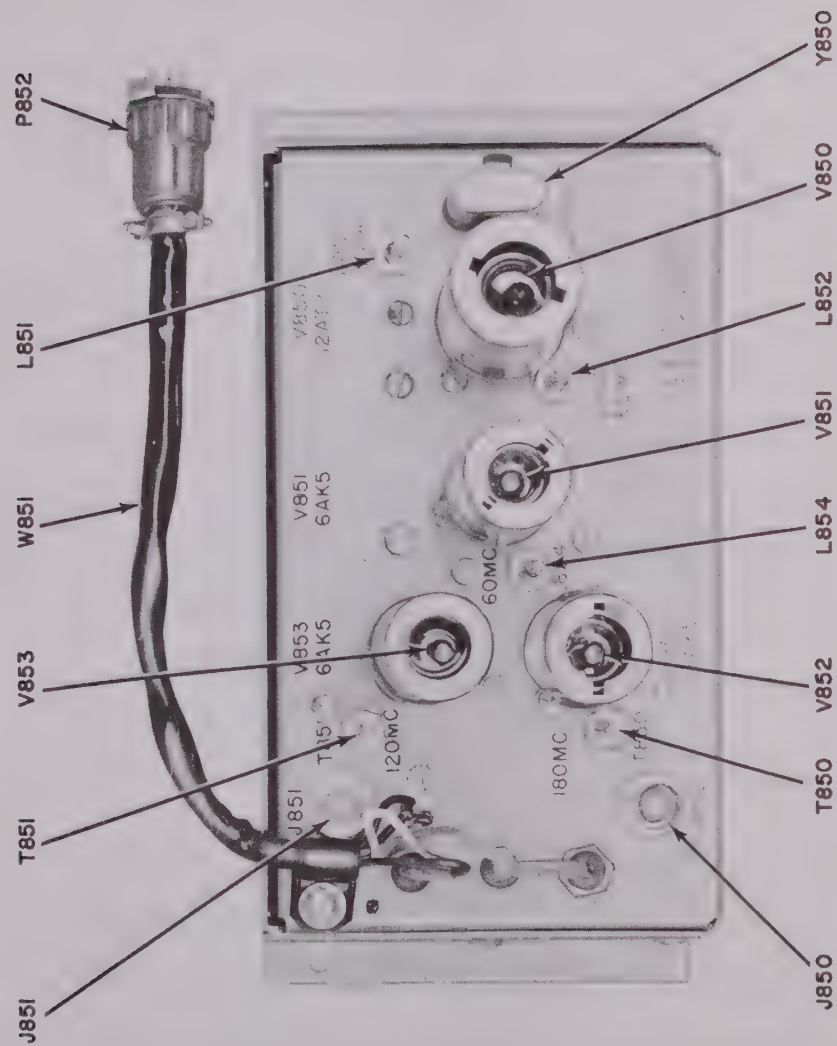


Figure 4-14. Crystal-Controlled Local Oscillator, Component Location Diagram (Sheet 1 of 3)

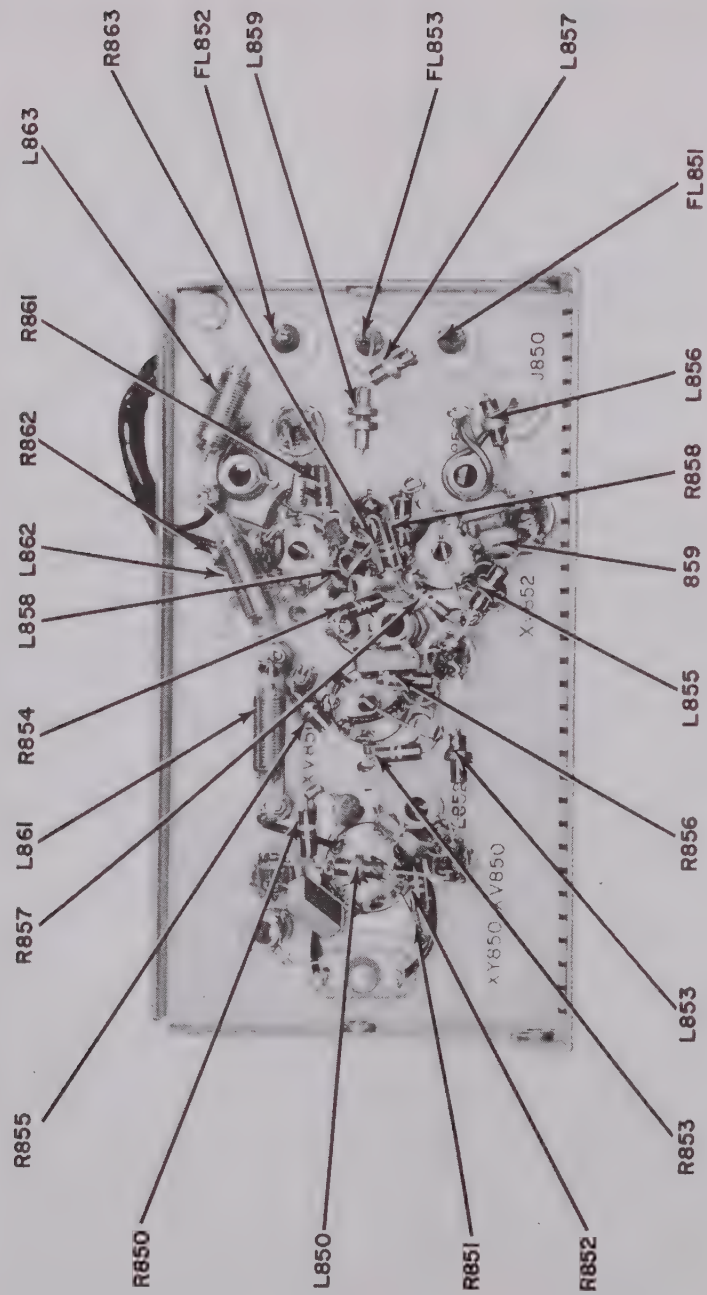


Figure 4-14. Crystal-Controlled Local Oscillator, Component Location Diagram (Sheet 3 of 3)

Table 4-7. Crystal-Controlled Local Oscillator,
Voltage and Resistance Measurements

Socket	Tube Type	Pin Number									
		1	2	3	4	5	6	7	8	9	
XV850	12AT7	+130	0	+1.25	0	0	+130	0	+1.25	6.3AC	Volts
		4.5K	15K	220	0	0	6.5K	0	250	0.2	Ohms
XV851	6AK5	-1.2	+2.0	6.3AC	0	+130	+120	+2.0			Volts
		25K	200	0.2	0	7K	12K	200			Ohms
XV852	6AK5	-5.4	+2.0	6.3AC	0	+130	+120	+2.0			Volts
		30K	200	0.2	0	7K	12K	200			Ohms
XV853	6AK5	-5.0	+2.0	6.3AC	0	+130	+120	+2.0			Volts
		25K	200	0.2	0	7K	12K	200			Ohms

Notes:

1. Voltage readings taken with a 20,000 ohm-per-volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.

4-19. CRYSTAL-CONTROLLED LOCAL OSCILLATOR, ALIGNMENT.

4-20. Since the circuitry of this subassembly is crystal-controlled, alignment will necessitate only peaking adjustments and/or tube replacement. To align the crystal-controlled local oscillator, proceed as outlined in the following steps.

a. Connect an a-c vtvm, through a 1-megohm series resistor, between pin 2 of V850 and chassis ground.

NOTE:

Adjustment of variable inductor L851 is critical. Since the output level of the 120-mc and 180-mc stages is dependent upon the output of the 60-mc stage, improper or poor peaking of L851 will result in low output power of the following stages regardless of their peaking.

b. Adjust variable inductor L851 to peak the deflection of the vtvm pointer.

c. Connect the vtvm and 1-megohm series resistor between pin 1 of V851 and chassis ground.

d. Adjust variable inductor L852 to peak the deflection of the vtvm pointer.

e. Connect the vtvm and 1-megohm series resistor between pin 1 of V852 and chassis ground.

f. Adjust variable inductor L854 to peak the deflection of the vtvm pointer.

g. Connect a d-c vtvm, through the 50-ohm crystal detector, to coaxial output jack J850, as shown in figure 4-12, sheet 5 of 7.

h. Adjust tunable transformer T850 to peak the deflection of the vtvm pointer. The vtvm should deflect to an indication of from 1.3 to 1.5 volts.

i. Connect the d-c vtvm, through the 50-ohm crystal detector, to coaxial output jack J851, as shown in figure 4-12, sheet 2 of 7.

j. Adjust tunable transformer T851 to peak the deflection of the vtvm pointer. The vtvm pointer should deflect to an indication of from 1.0 to 1.5 volts.

4-21. If the output levels specified in steps h and j, above, cannot be obtained, check the grid-to-ground voltages of the individual tubes within the subassembly with a d-c vtvm and 1-megohm series resistor. The following approximate voltage indications should be obtained.

- a. Between pin 2 of V850 and ground -3.5 volts
- b. Between pin 1 of V851 and ground -6.5 volts
- c. Between pin 1 of V852 and ground -14 volts
- d. Between pin 1 of V853 and ground -8.5 volts

4-22. After the crystal-controlled local oscillator has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 417, steps a through f.

4-23. 260/140-MC PREAMPLIFIER, TROUBLESHOOTING.

4-24. To remove the 260/140-mc preamplifier subassembly from the Basic Unit for troubleshooting and effecting necessary repairs, proceed as outlined in the following steps.

- a. Disconnect P801 from J801.
- b. Disconnect P802 from J802.
- c. Disconnect P803 from J803.
- d. Loosen and remove the four screws that secure the subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.

e. Remove the 260/140-mc preamplifier from the Basic Unit by disconnecting P804 from J103 and withdrawing the subassembly.

f. Loosen and remove the four screws that secure the mounting plate to the subassembly. Again, place the screws and their associated hardware in an accessible location.

g. Remove the mounting plate from the 260/140-mc preamplifier chassis. The components that constitute the subassembly will now be visible and accessible.

4-25. A defect within the 260/140-mc preamplifier can be located through the component location diagram supplied in figure 4-15, the voltage and resistance diagram supplied in figure 4-16, and the schematic diagram of the subassembly supplied in figure 5-5.

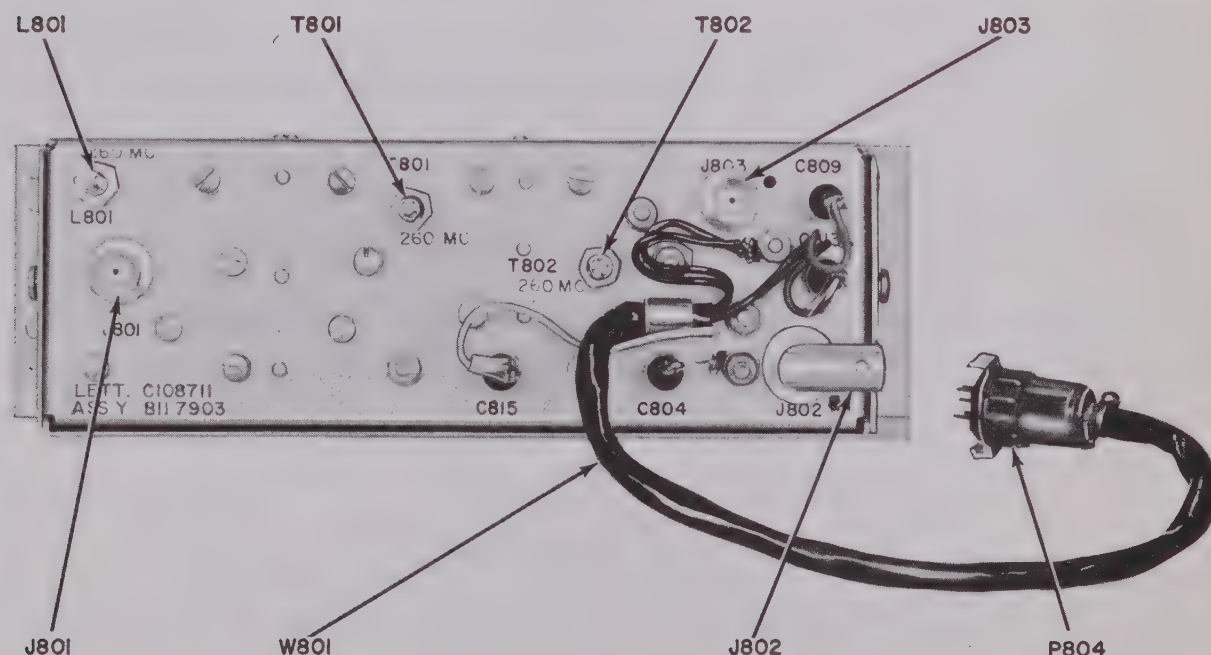


Figure 4-15. 260/140-Mc Preamplifier, Component Location Diagram (Sheet 1 of 3).

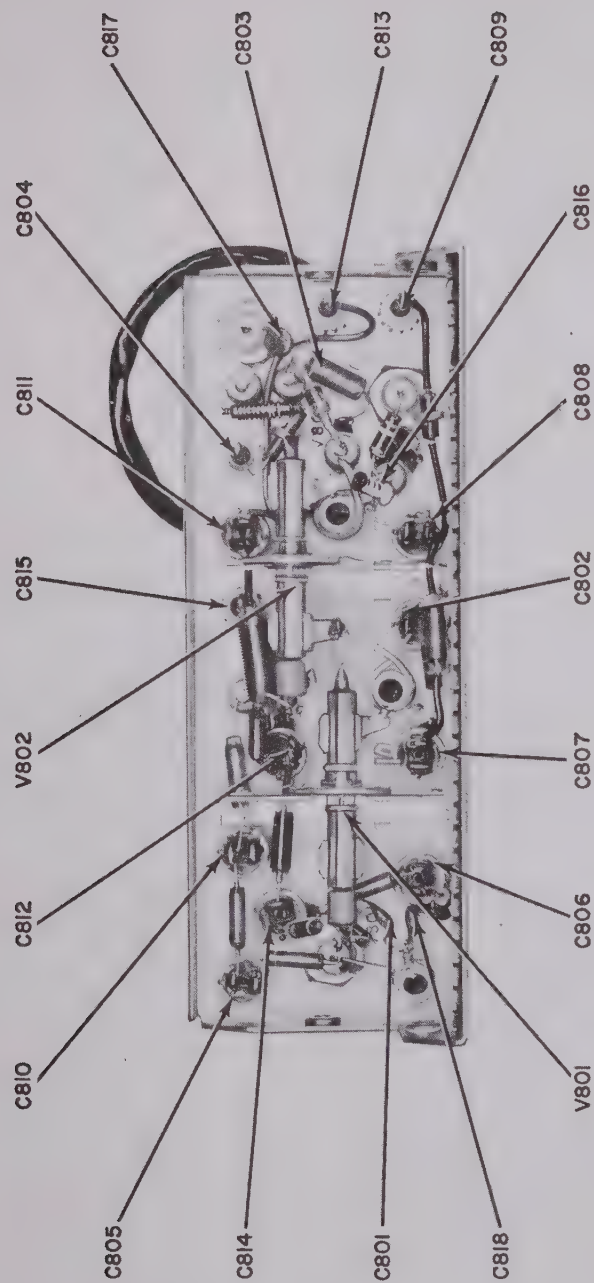


Figure 4-15. 260/140-Mc Preamplifier, Component Location
Diagram (Sheet 2 of 3)

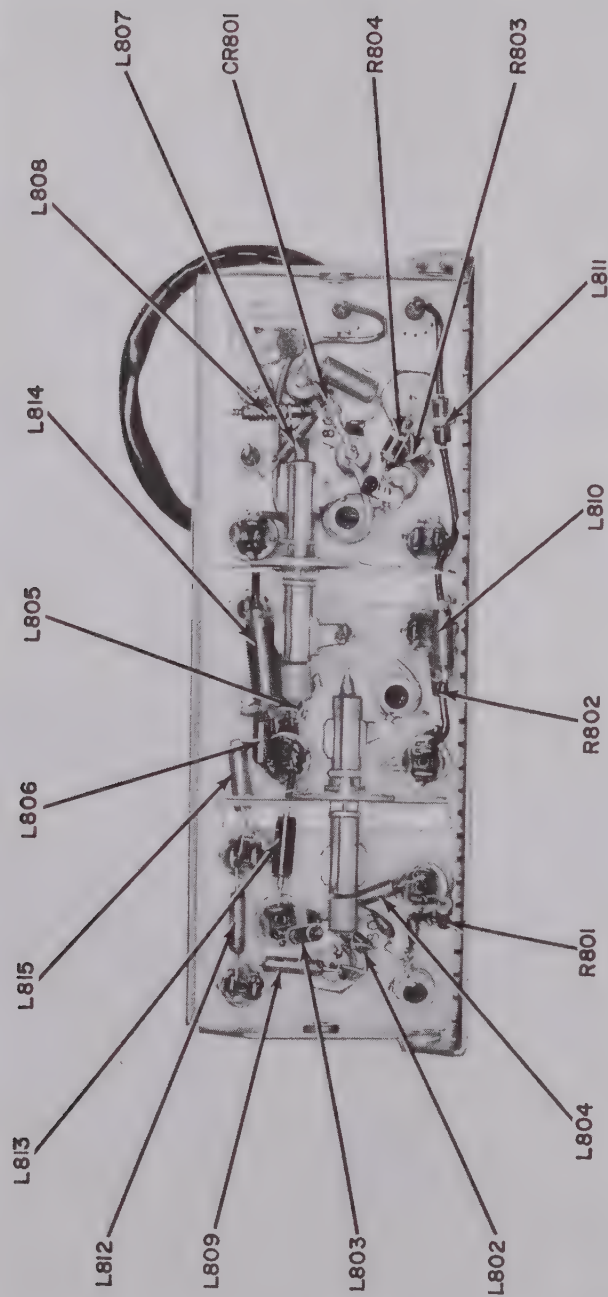


Figure 4-15. 260/140-Mc Preamplifier, Component Location
Diagram (Sheet 3 of 3)

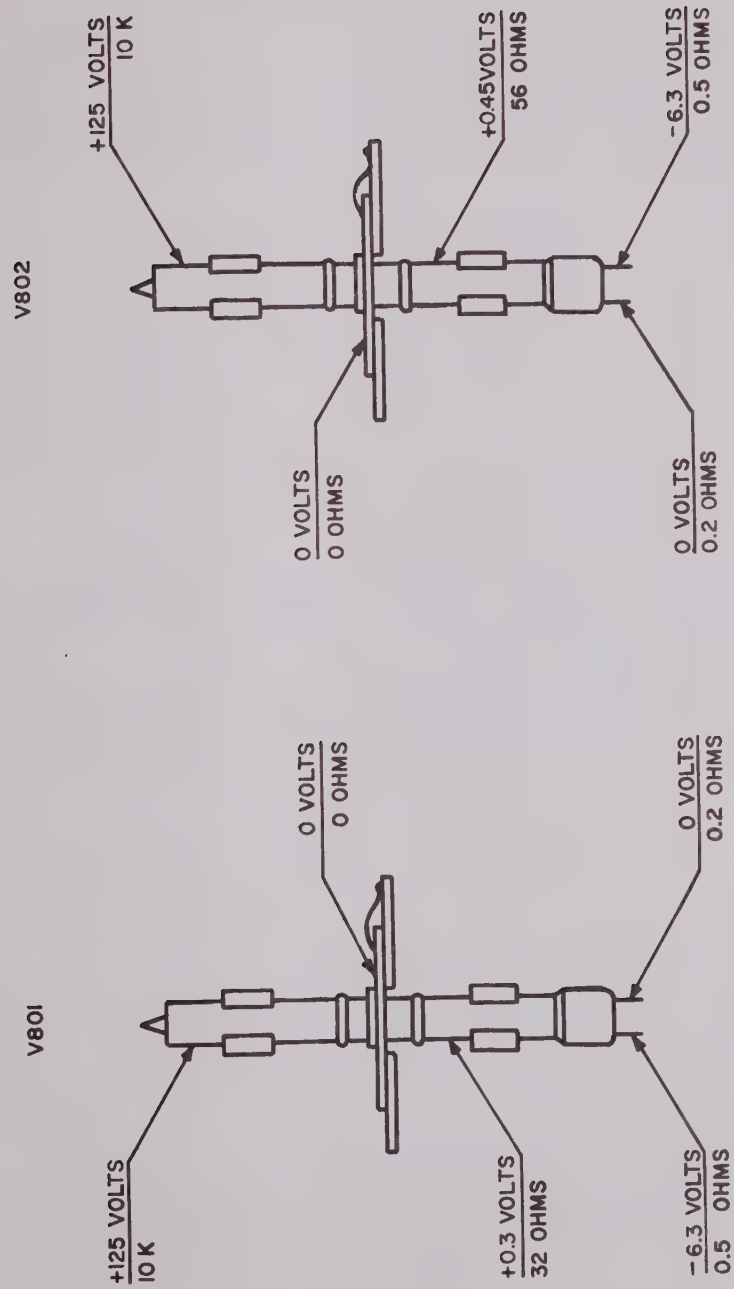


Figure 4-16. 260/140-Mc Preamplifier, Voltage and Resistance Diagram

4-26. 260/140-MC PREAMPLIFIER, ALIGNMENT.

4-27. To align the 260/140-mc preamplifier subassembly, proceed as outlined in the following steps.

NOTE:

The following procedure is valid only if the 140-mc i-f attenuator, 140/40-mc i-f amplifier, and crystal-controlled local oscillator subassemblies are functioning properly.

- a. Connect P802 to J802.
- b. Connect P803 to J803.
- c. Set the OUTPUT switch to ZERO SET.
- d. Connect the positive probe of a d-c vtvm to TP900 (located on the 140/40-mc i-f amplifier subassembly). Connect the common probe to chassis ground.
- e. Connect a calibrated signal generator, tuned to 260 mc, to coaxial input jack J801.
- f. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.
- g. Adjust the IF GAIN control to a front-panel indication of 6.
- h. Adjust the output level of the signal calibrator to obtain a vtvm pointer deflection of approximately five volts.
- i. Adjust tunable transformer T802 to peak the deflection of the vtvm pointer.
- j. Adjust tunable transformer T801 to obtain maximum deflection of the vtvm pointer.
- k. Adjust variable inductor L801 to further peak the deflection of the vtvm pointer. Reduce the output level of the signal generator, if necessary, to maintain the vtvm pointer deflection on-scale.

4-28. SENSITIVITY CHECK. To check the sensitivity of the 260/140-mc preamplifier (in series with the 140/40-mc i-f amplifier), proceed as outlined in the following steps.

a. Adjust the calibrated signal generator to obtain the minimum output level at 260 mc.

b. With the d-c vtvm still connected between TP900 of the 140/40-mc i-f amplifier and chassis ground, adjust the IF GAIN control to obtain a vtvm pointer deflection of 1 volt.

c. Adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of 1.41 volts. The amplitude of the 260-mc signal necessary to produce this indication should be no greater than 3 microvolts.

4-29. BANDWIDTH CHECK. To check the bandwidth of the series combination of the 260/140-mc preamplifier and the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

a. With the d-c vtvm still connected between TP900 and chassis ground, adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of 10 volts.

b. Detune the calibrated signal generator, while maintaining its output level at a constant level, to obtain both the upper and lower 3-db points (vtvm pointer deflecting to an indication of 7.07 volts). A 3-db bandwidth of 3.5 mc indicates satisfactory operation.

c. Repeat steps a and b, above, to obtain both the upper and lower 6-db points (vtvm pointer deflection of 5 volts). A 6-db bandwidth of between 4.5 and 5.5 mc indicates satisfactory equipment operation.

4-30. After the 260/140-mc preamplifier subassembly has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 4-23, steps a through g.

4-31. 140-MC I-F ATTENUATOR, TROUBLESHOOTING.

4-32. To remove the 140-mc i-f attenuator subassembly from the Basic Unit for troubleshooting and effecting necessary repairs, proceed as outlined in the following steps.

- a. Disconnect P326 from J326.
- b. Disconnect P325 from J325.
- c. Remove the plastic front panel cover of the output meter.
- d. Loosen (but do not remove) the screws which secure the output meter to the Basic Unit front panel.

- e. Loosen and remove the four screws that secure the 140-mc i-f attenuator subassembly to the Basic Unit front panel. Place the screws and their associated hardware in an accessible location.

- f. Carefully remove the five plastic push-buttons from the 140-mc i-f attenuator subassembly switch shafts. Place these buttons with the mounting hardware.

- g. Remove the subassembly from the Basic Unit.

- h. Loosen and remove the four screws that secure the cover plate to the subassembly. Again, place the screws and their associated hardware in an accessible location.

1. Remove the cover plate from the subassembly. The components that constitute the 140-mc i-f attenuator will now be visible and accessible.

4-33. A defect within the 140-mc i-f attenuator subassembly can be located through the component location diagram supplied in figure 4-17 and the schematic diagram of the subassembly supplied in figure 5-5.

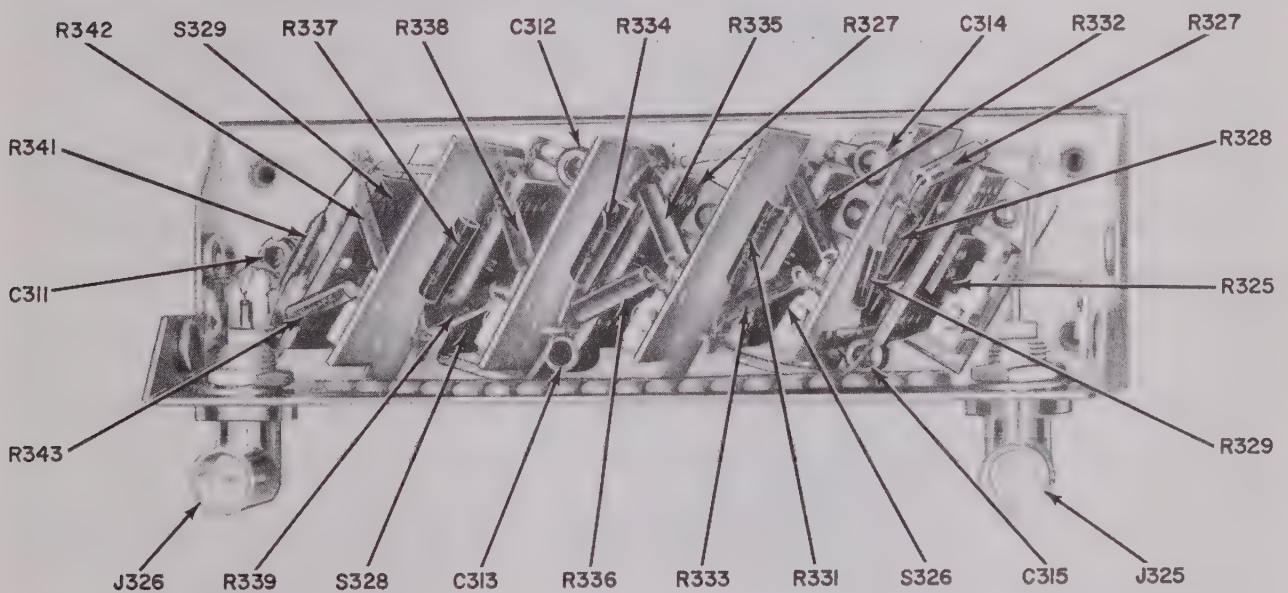


Figure 4-17. 140-Mc I-f Attenuator, Component Location Diagram.

4-34. 140-MC I-F ATTENUATOR, ALIGNMENT.

4-35. Since the 140-mc i-f attenuator subassembly is of the compensated section type, alignment will necessitate the adjustment of the compensating capacitors of the stage(s) that was (were) repaired. To align the capacitors, proceed as outlined in the following steps.

a. Connect a calibrated signal generator, tuned to 140 mc and adjusted for a convenient output level, to the input jack of a standard 50-ohm i-f attenuator, as shown in figure 4-18a.

b. Connect the output of the standard 50-ohm i-f attenuator to J900 of the 140/40-mc i-f amplifier, as shown in figure 4-18a.

c. Insert the amount of i-f attenuation corresponding to that stage of the 140-mc i-f attenuator that was repaired.

d. Note the output meter pointer deflection.

e. Replace the standard 50-ohm i-f attenuator with the 140-mc i-f attenuator, as shown in figure 4-18b.

f. Depress the push-button switch to insert the repaired stage of attenuation. All other stages should not be inserted into the circuit.

g. Note the output meter pointer deflection. Adjust the appropriate compensating capacitor so that the output meter pointer deflection is the same as that of step d, above.

h. Repeat steps a through g, if necessary, for all other stages that were repaired.

4-36. After the 140-mc i-f attenuator assembly has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 4-32, steps a through i.

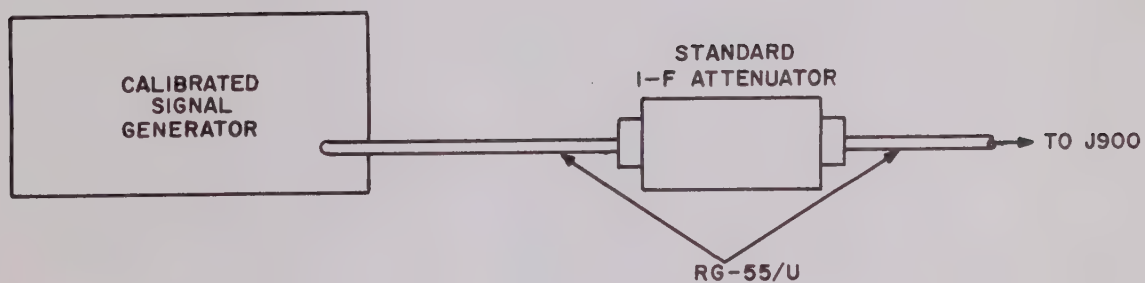
4-37. 140/40-MC I-F AMPLIFIER, TROUBLESHOOTING.

4-38. To remove the 140/40-mc i-f amplifier subassembly from the Basic Unit frame, proceed as outlined in the following steps.

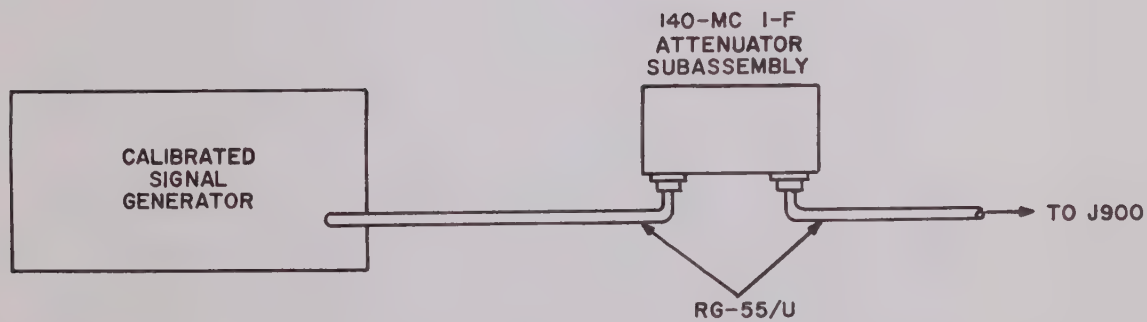
a. Disconnect P900 from J900.

b. Disconnect P901 from J901.

c. Disconnect P902 from J902.



(a)



(b)

Figure 4-18. 140-Mc I-f Attenuator Alignment,
Equipment Set Up

- d. Disconnect P903 from J903.
- e. Disconnect P904 from J904.
- f. Loosen and remove the four screws that secure the 140/40-mc i-f amplifier subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.
- g. Disconnect P905 from J105 and remove the subassembly from the Basic Unit.
- h. Loosen and remove the four screws that secure the mounting plate to the 140/40-mc i-f amplifier chassis. Again, place the screws and their associated hardware in an accessible location.
- i. Remove the mounting plate from the 140/40-mc i-f amplifier chassis. The individual components that constitute the chassis will now be visible and accessible.

4-39. A defect within the 140/40-mc i-f amplifier can be found by use of the component location diagram supplied in figure 4-19, the voltage and resistance measurements supplied in table 4-8, and the schematic diagram of the subassembly supplied in figure 5-5.

NOTE:

When making voltage and resistance measurements, be sure to connect P905 to J105, thereby coupling the 140/40-mc i-f amplifier to the remainder of the FIM-2 system.

4-40. 140/40-MC I-F AMPLIFIER, ALIGNMENT.

4-41. 40-MC STAGES. To align the 40-mc stages of the 140/40-mc i-f amplifier subassembly, proceed as outlined in the following steps.

- a. With a d-c vtvm connected between TP359 and chassis ground (positive probe connected to TP359), adjust Scale Tracking control R359 to obtain a vtvm pointer deflection of 0 volts.

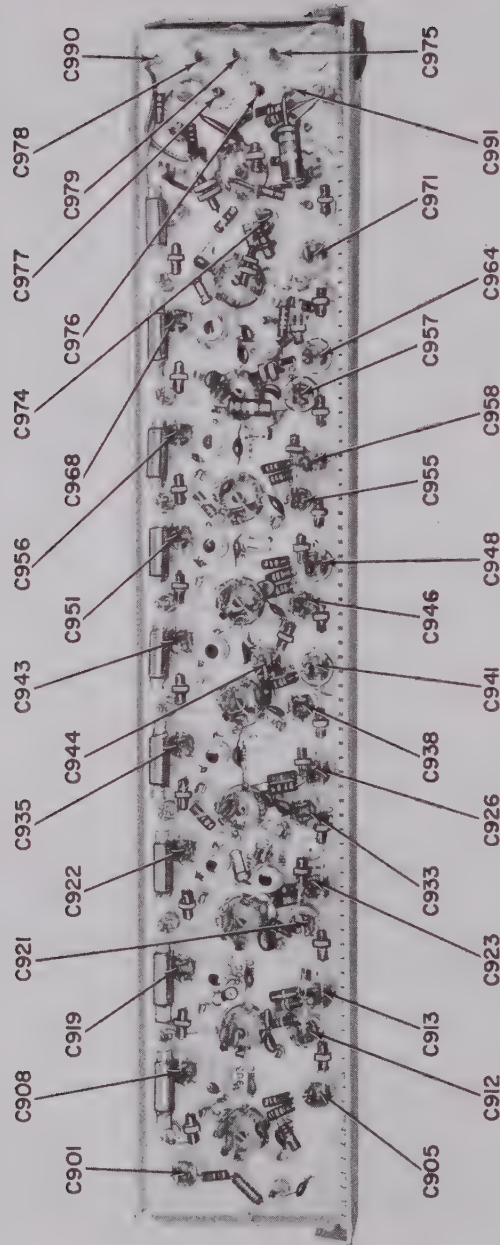


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram
(Sheet 2 of 5)

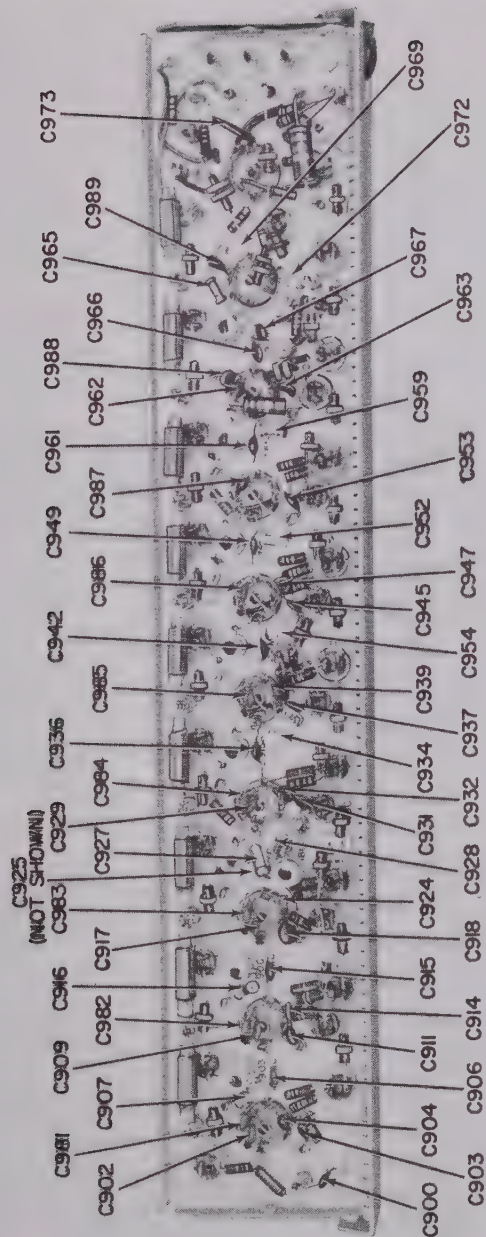


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram
(Sheet 3 of 5)

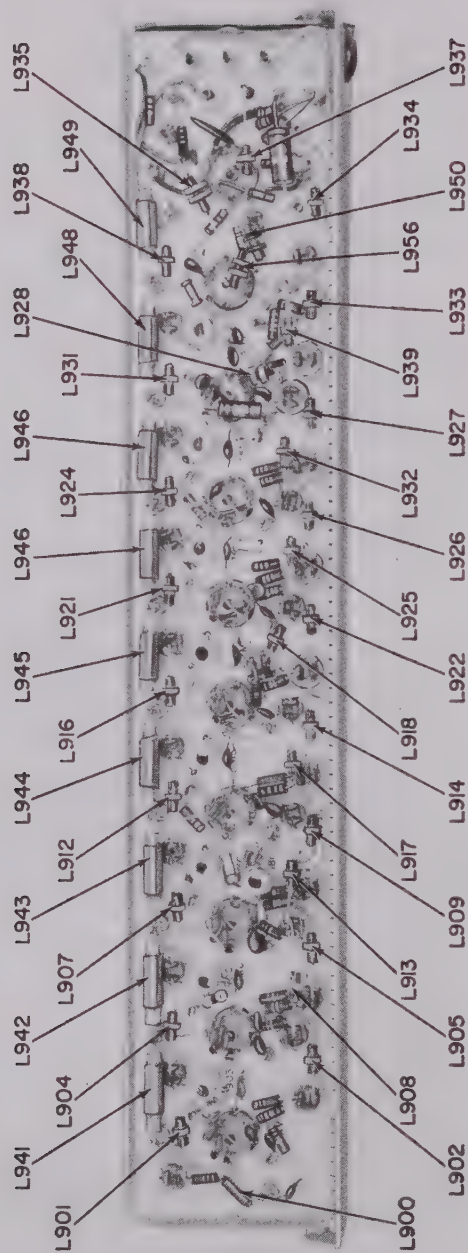


Figure 4-19. 140/40-mc I-f Amplifier, Component Location Diagram
(Sheet 4 of 5)

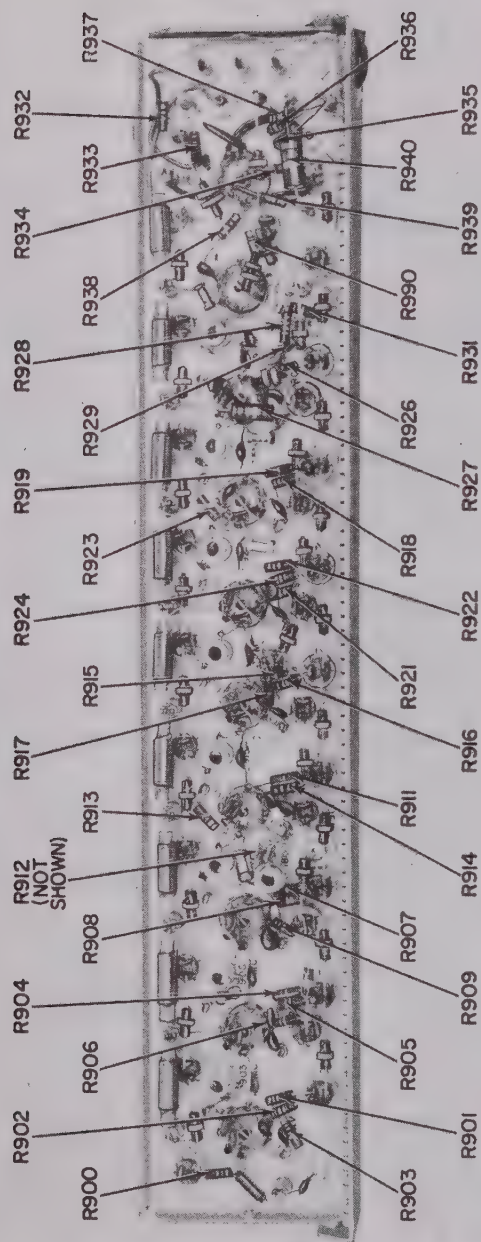


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram
(Sheet 5 of 5)

Table 4-8. 140/40-Mc I-f Amplifier, Voltage and Resistance Measurements

Socket	Tube Type	Pin Number									
		1	2	3	4	5	6	7	8	9	
XV900	6AK5	+0.95 290K	+2.3 220	6.3AC 0.2	0 0	+105 9K	+80 22K	+2.3 220			Volts Ohms
XV901 ³	6AK5	0 0	+1.6 220	6.3AC 0.2	0 0	+105 9K	+95 23K	+1.6 220			Volts Ohms
XV902 ³	6AK5	0 0	+1.5 220	6.3AC 0.2	0 0	+115 8K	+95 24K	+1.5 220			Volts Ohms
XV903	6AK5	0 0	+1.6 380	6.3AC 0.2	0 0	+115 8K	+85 42K	+1.6 380			Volts Ohms
XV904	6AK5	+0.95 290K	+2.5 220	6.3AC 0.2	0 0	+105 8K	+100 18K	+2.5 220			Volts Ohms
XV905	6AK5	+0.95 290K	+2.5 220	6.3AC 0.2	0 0	+100 8K	+95 18K	+2.5 220			Volts Ohms
XV906	6AK5	0 0	+1.8 180	6.3AC 0.2	0 0	+105 8K	+125 6K	+1.8 180			Volts Ohms
XV907	6AN5	0 0	+5.6 150	6.3AC 0.2	0 0	+125 7K	+125 7K	+5.6 150			Volts Ohms
XV908	6AL5	+1.1 600	0 0	6.3AC 0.2	0 0	+47 2K	NC	-50 5K			Volts Ohms
XV909	5687	+125 7K	0 5K	+2.5 22K	6.3AC 0.2	6.3AC 0.2	+10 750	+0.25 600K	0 0	+125 7K	Volts

- NOTES: 1. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
 2. Resistance readings taken with power cable removed.
 3. IF GAIN control rotated fully clockwise.

b. With the d-c vtvm connected between TP358 and chassis ground (positive probe connected to TP358), adjust Average Low Set control R362 to obtain a vtvm pointer deflection of 0.75 volts.

c. Set the OUTPUT switch to ZERO SET.

d. Connect the d-c vtvm between TP900 and chassis ground (positive probe connected to TP900).

e. Connect a calibrated signal generator, tuned to 40 mc and adjusted to obtain a convenient reference deflection on the vtvm, to coaxial input jack J901.

f. Adjust tunable transformer T901 to obtain maximum deflection of the vtvm pointer.

g. Repeat step e, above, for calibrated signal generator frequencies listed below in table 4-9 (the output level being adjusted for a convenient reference deflection), adjusting the indicated controls to peak the deflection of the vtvm pointer.

TABLE 4-9. TUNING SEQUENCE, 40-MC STAGES.

Step	Generator Frequency	Tune Variable Inductor
1	37.5 mc	L929
2	42.6 mc	L923
3	37.7 mc	L919
4	42.3 mc	L915

h. After satisfactory peaking indications have been obtained, connect P901 to J901 and proceed to paragraph 4-42.

4-42. 140-MC STAGES. To align the 140-mc stages of the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

a. Connect the calibrated signal generator, tuned to 140-mc, to coaxial input jack J900.

b. Adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of approximately 5 volts.

c. Adjust tunable transformer T900 to obtain maximum deflection of the vtvm pointer.

d. Adjust variable inductor L911 to peak the deflection of the vtvm pointer.

e. Tune the calibrated signal generator to 137 mc.

f. Adjust variable inductor L906 to obtain maximum deflection of the vtvm pointer.

g. Tune the calibrated signal generator to 143 mc.

h. Adjust variable inductor L903 to obtain maximum deflection of the vtvm pointer.

i. After satisfactory peaking of the 140/40-mc i-f amplifier has been completed, proceed to paragraphs 4-43 and 4-44, in sequence, to check the sensitivity and bandwidth, respectively, of the subassembly.

4-43. SENSITIVITY CHECK. To check the sensitivity of the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

a. Tune the calibrated signal generator to 140 mc and adjust for minimum output level.

b. Adjust the IF GAIN control to obtain a vtvm pointer deflection of 1 volt. This corresponds to the noise level of the subassembly.

c. Adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of 1.41 volts, which corresponds to signal plus noise being equal to twice the noise. The amplitude of the 140-mc signal necessary to produce this indication

should be no greater than 4 microvolts.

4-44. BANDWIDTH CHECK. To check the bandwidth of the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

- a. Adjust the IF GAIN control to a front-panel indication of 6.
- b. Adjust the output level of the calibrated signal generator, which is still tuned to 140 mc, to obtain a vtvm pointer deflection of 10 volts.
- c. Detune the calibrated signal generator, maintaining its output level constant, to obtain the upper and lower 3-db points (vtvm pointer indication of 7.07 volts). A 3-db bandwidth of approximately 4.5 mc indicates satisfactory operation.
- d. Repeat step c, above, to obtain the upper and lower 6-db points (vtvm pointer deflection of 5 volts). A 6-db bandwidth of between 5.5 and 6.0 mc indicates satisfactory operation.

4-46. AUDIO-METERING CHASSIS, TROUBLESHOOTING.

4-47. A defect within the audio-metering chassis can be localized through the component location diagram supplied in figure 4-20, the voltage and resistance measurements supplied in table 4-10, and the schematic diagram of the subassembly supplied in figure 5-5.

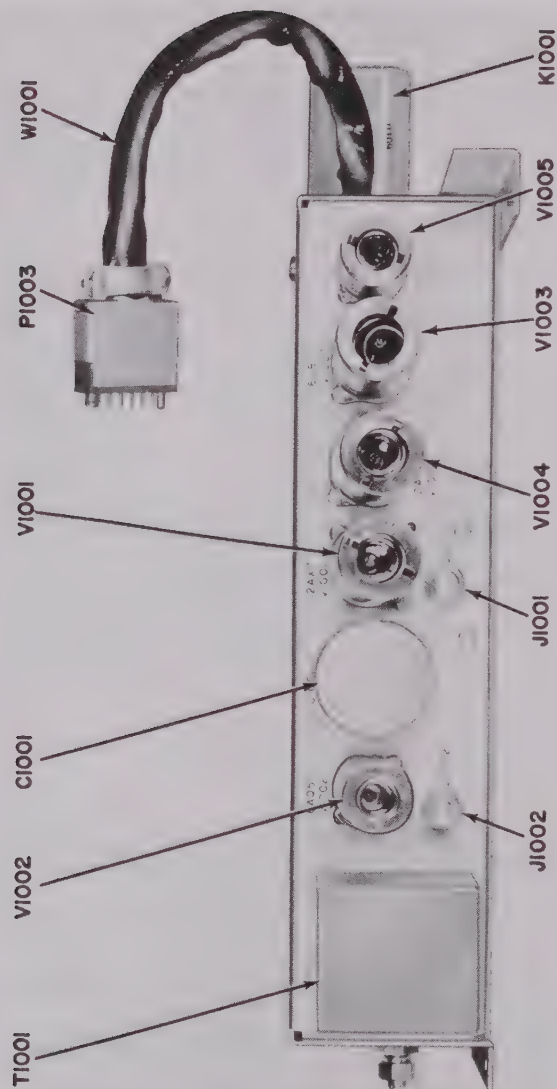


Figure 4-20. Audio-Metering Chassis, Component Location Diagram
(Sheet 1 of 2)

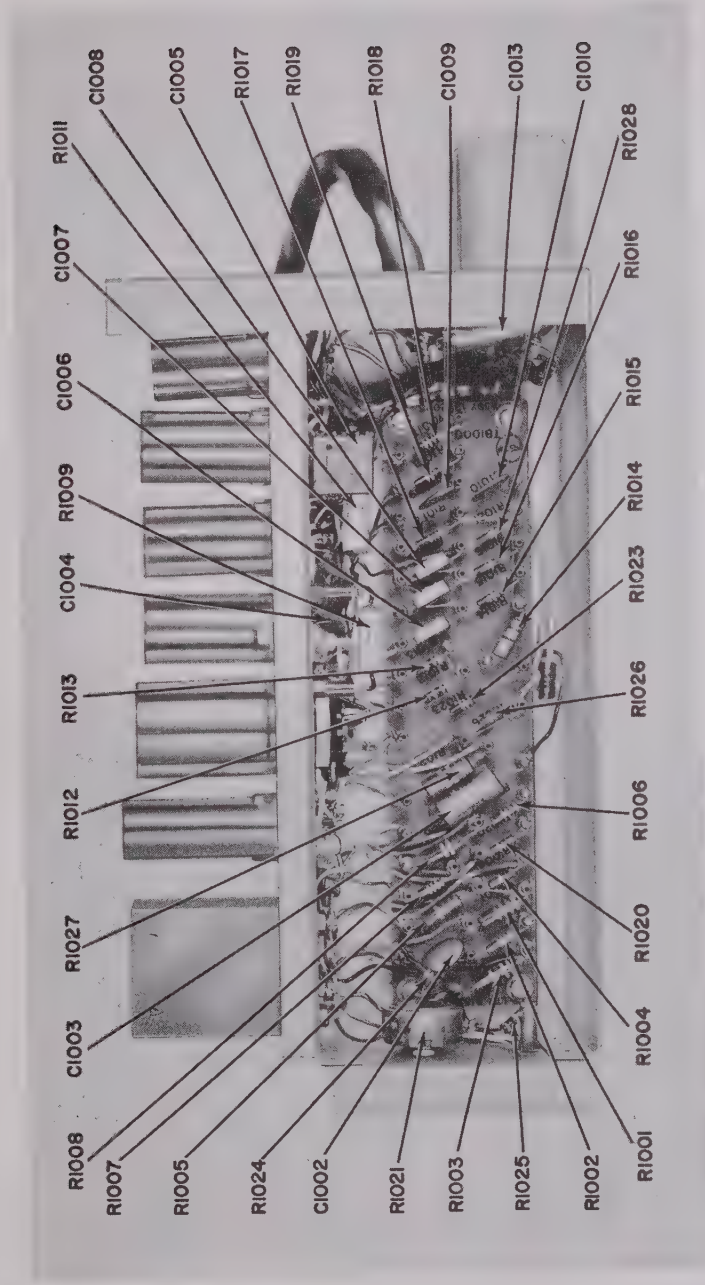


Figure 4-20. Audio-Metering Chassis, Component Location Diagram
(Sheet 2 of 2)

Table 4-10. Audio-Metering Chassis, Voltage and Resistance Measurements

Socket	Tube Type	Pin Number								
		1	2	3	4	5	6	7	8	9
XV1001	12AX7	+105 55	0 Inf	0 220	0 0	0 0	+125 290K	0 750K	+1.3 240K	-6.3 0
XV1002	6AQ5	0 450K	+6 400	0 0	-6.3 0	+105 8K	+110 8K	0 450K		
XV1003	6U8	+125 290K	0 Inf	0 Inf	0 0	-6.3 0	0 Inf	0 750K	+4 3.2K	+0.9 270K
XV1004 ⁴	12AT7	+125 6.5K	+20 450K	+25 5K	0 0	0 0	+125 6.5K	+20 450K	+26 10K	-6.3 0
XV1005 ⁴	6AU6	0 125K	+1.4 4.5K	0 0	-6.3 0	+20 450K	+34 800K	+1.4 4.5K		

- NOTES: 1. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
 2. Resistance readings taken with power cable removed.
 3. OUTPUT switch set to PEAK.
 4. AURAL AID and AUDIO GAIN controls rotated fully clockwise.

4-48. WEIGHTING CIRCUITRY, TROUBLESHOOTING.

4-49. To troubleshoot the weighting circuitry, check the components mounted on OUTPUT switch S301, using the schematic diagram of the switch and its associated circuitry that is supplied in figure 5-6. Also check the components mounted on terminal board assemblies TB300 and TB301, as shown in figures 4-21 and 4-22, respectively.

4-50. OUTPUT METER SCALE TRACKING.

4-51. Repair and/or realignment of any subassembly ahead of the output meter will necessitate retracking of the output meter to adjust the output characteristics of the i-f circuitry to the screening on the output meter panel. The controls employed in the retracking of the output meter are located on both the meter adjust board and the low-voltage power supply. To retrack the output meter, proceed as outlined in the following steps.

NOTE:

The accuracy of the output meter scale tracking procedure depends on the signal level applied to the i-f circuitry. This, in turn, depends on the sensitivity of the Tuning Unit installed in the Basic Unit. The tracking procedures listed below are based on the assumption that the Tuning Unit in use meets the minimum sensitivity specification of -81 dbm.

- a. With the POWER switch set to OFF, insert a Tuning Unit into the Basic Unit.
- b. Set the POWER switch to ON. Allow the FIM-2 to warm up for at least 15 minutes.
- c. Connect i-f cable assembly W1204 as a jumper between the MIXER OUT and IF IN jacks.
- d. Set the FUNCTION SEL switch to ZERO SET.
- e. Connect r-f cable assembly W1204 as a jumper between the

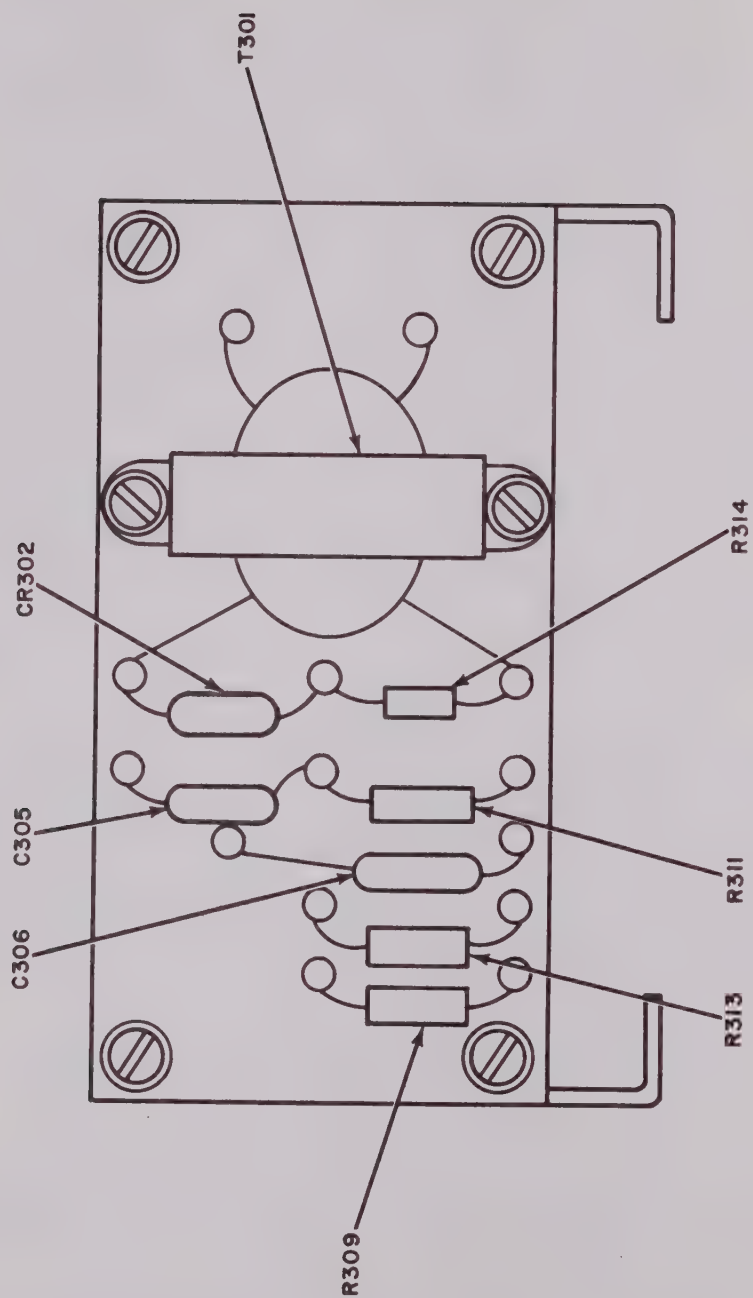


Figure 4-21. Terminal Board Assembly TB300, Component Location Diagram

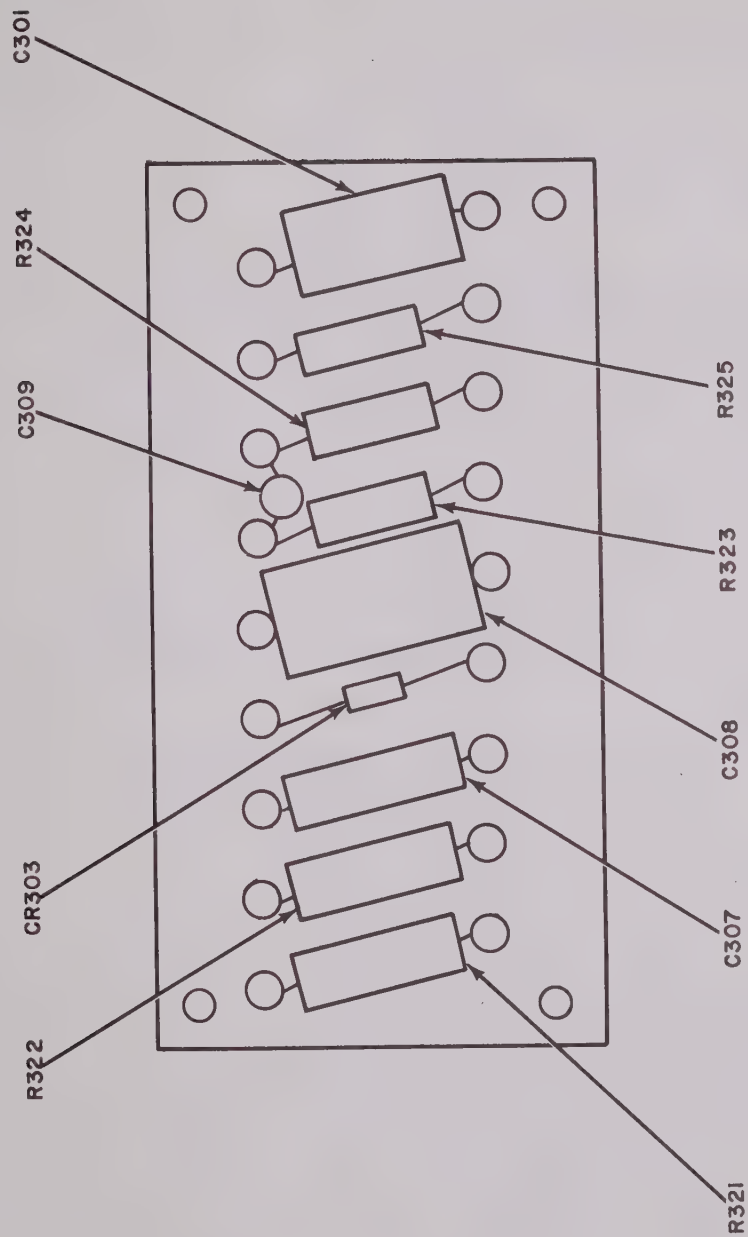


Figure 4-22. Terminal Board Assembly TB301, Component Location Diagram

SIG GEN OUT jack and the PRESEL IN jack.

f. Set the AFC switch to OUT.

g. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.

h. Set the OUTPUT switch to ZERO SET.

i. Adjust the output meter ZERO SET control to zero-set the output meter.

WARNING:

Before removing a vacuum tube from its socket, first place a handkerchief over the tube shield to dissipate the heat. When the tube shield is cool to the touch, remove it and repeat the procedure for the tube.

j. Remove V906 (6AK5) from the 140/40-mc i-f amplifier sub-assembly.

k. Set the OUTPUT switch to QUASI-PEAK.

l. Adjust Meter Signal Adj control R128 to zero-set the output meter.

m. Set the OUTPUT switch to AVERAGE.

n. Adjust Avg Mtg Position control R122 to zero-set the output meter.

o. Repeat steps k through n, above, until there is no difference between zero-set indications for both the QUASI-PEAK and AVERAGE positions of the OUTPUT switch.

p. Rotate the IF GAIN control fully counterclockwise.

q. Replace V906.

r. Set the OUTPUT switch to QUASI-PEAK.

s. Adjust Q.P. Low Set control R361, if necessary, to zero-set the output meter.

t. Set the OUTPUT switch to AVERAGE.

u. Adjust Average Low Set control R362, if necessary, to

zero-set the output meter.

v. Repeat steps r through u, above, until there is no difference between the zero-set indications for both the QUASI-PEAK and AVERAGE positions of the OUTPUT switch.

w. Rotate Meter Sensitivity control R351 fully counterclockwise.

x. Rotate Scale Tracking control R368, fully clockwise.

y. Disconnect P900 from J900.

z. Connect a calibrated signal generator, tuned to 140 mc, to J900.

aa. Adjust the output level of the calibrated signal generator to 4 microvolts.

ab. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale.

ac. Adjust the output level of the calibrated signal generator to 400 microvolts.

ad. Note the output meter pointer deflection. It should deflect to an indication less than 1000 on the RF UV scale.

ae. Adjust Meter Sensitivity control R351 to obtain an output meter pointer deflection of 1000 on the RF UV scale.

af. Repeat steps aa through ae, above, until the output meter pointer deflection corresponds to 1000 on the RF UV scale when the output level of the calibrated signal generator is 400 microvolts.

ag. Disconnect the calibrated signal generator from J900.

ah. Connect P900 to J900.

ai. Rotate the TUNING control to any desired frequency, as indicated on the FREQUENCY IN KILOMEGACYCLES dial.

aj. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to 0.

ak. Rotate the SIGNAL CALIBRATOR FINE TUNING control to 0.

al. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

am. Set the FUNCTION SEL switch to CAL SIG GEN.

an. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL (0).

ao. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 65 mark on the -dbm scale of the -DBM MICROVOLTS dial beneath the power set indicator hairline.

ap. Adjust the SIGNAL CALIBRATOR COARSE TUNING control to obtain maximum deflection of the output meter pointer.

aq. Adjust the SIGNAL CALIBRATOR FINE TUNING control to peak the deflection of the output meter pointer.

ar. Readjust the SIGNAL CALIBRATOR POWER SET control, if necessary, to maintain a power monitor meter pointer deflection of CAL (0).

as. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the -DBM MICROVOLTS dial beneath the power set indicator hairline.

at. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

au. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 100 mark on the microvolts scale of the -DBM MICROVOLTS dial beneath the power set indicator hairline.

av. Note the output meter pointer deflection. It should indicate 100 microvolts $\pm \frac{1}{2}$ db. If it does not, adjust Meter Sensitivity control R351 in such a manner as to increase the error slightly. Repeat steps as through au, above, as often as necessary to obtain an output meter pointer deflection of 1000 and 100 for SIGNAL CALIBRATOR -DBM MICROVOLTS dial indications of 1K and 100 microvolts, respectively.

aw. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 30 mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

ax. Note the output meter pointer deflection. It should deflect to an indication of 30 microvolts $\pm \frac{1}{2}$ db on the RF UV scale.

NOTE:

Do not alter either the output level of the signal calibrator or the setting of the IF GAIN control from this point until the end of the procedure UNLESS SPECIFICALLY INSTRUCTED TO DO SO. The three other positions of the OUTPUT switch, namely QUASI-PEAK, PEAK, and SLIDEBACK, will be set about the AVERAGE position of the OUTPUT switch.

ay. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

az. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

ba. Set the OUTPUT switch to QUASI-PEAK.

bb. Note the output meter pointer deflection. It should deflect to an indication of 1000 microvolts ± 0 db
 $- 1$ db.

bc. Set the OUTPUT switch to AVERAGE.

bd. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 200 on the RF UV scale.

be. Set the OUTPUT switch to QUASI-PEAK.

bf. Note the output meter pointer deflection. It should deflect to an indication of 200 microvolts ± 0 db. If it does not,
 $- 1$ db
adjust Q.P. Low Set control R361 to obtain an output meter pointer

deflection within the above limits.

bg. Set the OUTPUT switch to AVERAGE.

bh. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 100 on the RF UV scale.

bi. Set the OUTPUT switch to QUASI-PEAK.

bj. Note the output meter pointer deflection. It should deflect to an indication of 100 microvolts $\pm \frac{1}{2}$ db. If it does not, repeat steps ay through bi, above, until the limits specified in steps bb,bf, and bj are obtained.

bk. Set the OUTPUT switch to AVERAGE.

bl. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

bm. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

bn. Set the OUTPUT switch to PEAK.

bo. Note the output meter pointer deflection. It should deflect to an indication of 1000 microvolts $\pm \begin{matrix} 0 \\ 1 \end{matrix}$ db.

bp. Set the OUTPUT switch to AVERAGE.

bq. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 200 on the RF UV scale.

br. Set the OUTPUT switch to PEAK.

bs. Note the output meter pointer deflection. It should deflect to an indication of 200 microvolts $\pm \begin{matrix} 0 \\ -1 \end{matrix}$ db. If it does not, adjust Peak Low Set control R354 to obtain an output meter pointer

deflection within the above limits.

bt. Set the OUTPUT switch to AVERAGE.

bu. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 100 on the RF UV scale.

bv. Set the OUTPUT switch to PEAK.

bw. Note the output meter pointer deflection. It should deflect to an indication of 100 microvolts $\pm \frac{1}{2}$ db. If it does not, repeat steps bl through bv, above, until the limits specified in steps bo, bs, and bw are obtained.

bx. Set the OUTPUT switch to AVERAGE.

by. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

bz. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

ca. Set the OUTPUT switch to PEAK.

cb. Note the output meter pointer deflection. It should deflect to an indication of 1000 microvolts $\pm \begin{matrix} 0 \text{ db} \\ 1 \text{ db} \end{matrix}$.

cc. Plug a 600-ohm headset into the AUDIO OUT jack.

cd. Rotate the SLIDEBACK control fully clockwise.

ce. Adjust the AUDIO GAIN control to a front-panel indication of 5.

cf. Connect a square-wave generator, adjusted for 1000-cps at 50 volts peak-to-peak, to the EXT MOD jack.

cg. Place the headset over ears.

ch. Note the noise obtained from the headset.

ci. Rotate the SLIDEBACK control counterclockwise until the 1,000-pps modulation signal just emerges from the noise.

cj. Note the output meter pointer deflection. It should deflect to the same indication as in step cb.

ck. Rotate the SLIDEBACK control fully clockwise.

cl. Remove the headset from ears.

cm. Set the OUTPUT switch to PEAK.

cn. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 200 on the RF UV scale.

co. Set the OUTPUT switch to SLIDEBACK.

cp. Place the headset over ears.

cq. Note the noise obtained from the headset.

cr. Rotate the SLIDEBACK control counterclockwise until the 1,000-pps modulation signal just emerges from the noise.

cs. Note the output meter pointer deflection. It should deflect to an indication obtained in step cn. If it does not, adjust Slbk Low Set control R₅₉ to obtain an output meter pointer deflection specified above.

ct. Rotate the SLIDEBACK control fully clockwise.

cu. Remove the headset from ears.

cv. Set the OUTPUT switch to PEAK.

cw. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 100 on the RF UV scale.

cx. Set the OUTPUT switch to SLIDEBACK.

cy. Place the headset over ears.

cz. Note the noise obtained in the headset.

da. Rotate the SLIDEBACK control counterclockwise until the 1,000-cps modulation signal just emerges from the noise.

db. Note the output meter pointer deflection. It should be the same as in step cw. If it does not, repeat steps bx through da, above, until the limits specified in steps cj, cs, and db are obtained.

4-52. AFC-I-F AMPLIFIER, TROUBLESHOOTING.

4-53. To remove the afc-i-f amplifier from the Basic Unit for troubleshooting and effecting the necessary repairs, proceed as outlined in the following steps.

a. Disconnect P1050 from J1050.

WARNING:

THE OUTPUT OF THE AFC-I-F AMPLIFIER SUBASSEMBLY IS SUPERIMPOSED UPON THE REFLECTOR SUPPLY VOLTAGE. BE SURE TO REMOVE THE REFLECTOR VOLTAGE FROM THE SUBASSEMBLY BY DISCONNECTING P1051 FROM J104.

b. Disconnect P1051 from J104.

c. Disconnect P1052 from J101.

d. Loosen and remove the four screws that secure the subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.

e. Remove the afc-i-f amplifier subassembly from the Basic Unit.

f. Loosen and remove the four screws that secure the mount-

ing plate to the afc-i-f amplifier chassis. Again, place the screws and their associated hardware in an accessible location.

g. Remove the mounting plate from the afc-i-f amplifier subassembly. The individual components that constitute the subassembly will now be both visible and accessible.

4-54. A defect within the afc-i-f amplifier can be located through the component location diagram supplied in figure 4-23, the voltage and resistance measurements supplied in table 4-11, and the schematic diagram of the subassembly supplied in figure 5-5.

4-55. AFC-I-F AMPLIFIER, ALIGNMENT.

4-56. To align the afc-i-f amplifier, connect P1052 to J101, and proceed as outlined in the following steps.

a. Connect a calibrated signal generator, tuned to 40 mc and adjusted for an output level of 50,000 microvolts, to coaxial input jack J1050.

b. Connect the a-c probe of a vtvm to V1051, pin 1. Connect the common probe to chassis ground.

c. Adjust variable inductor L1050 to obtain maximum deflection of the vtvm pointer.

d. Connect the a-c probe of the vtvm to V1052, pin 1. The common probe should remain connected to chassis ground.

e. Adjust variable inductor L1052 to obtain maximum deflection of the vtvm pointer.

f. Connect the a-c probe of the vtvm to V1053, pin 1. The common probe should remain connected to chassis ground.

g. Adjust variable inductor L1054 to obtain maximum deflection of the vtvm pointer.



Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 1 of 4)

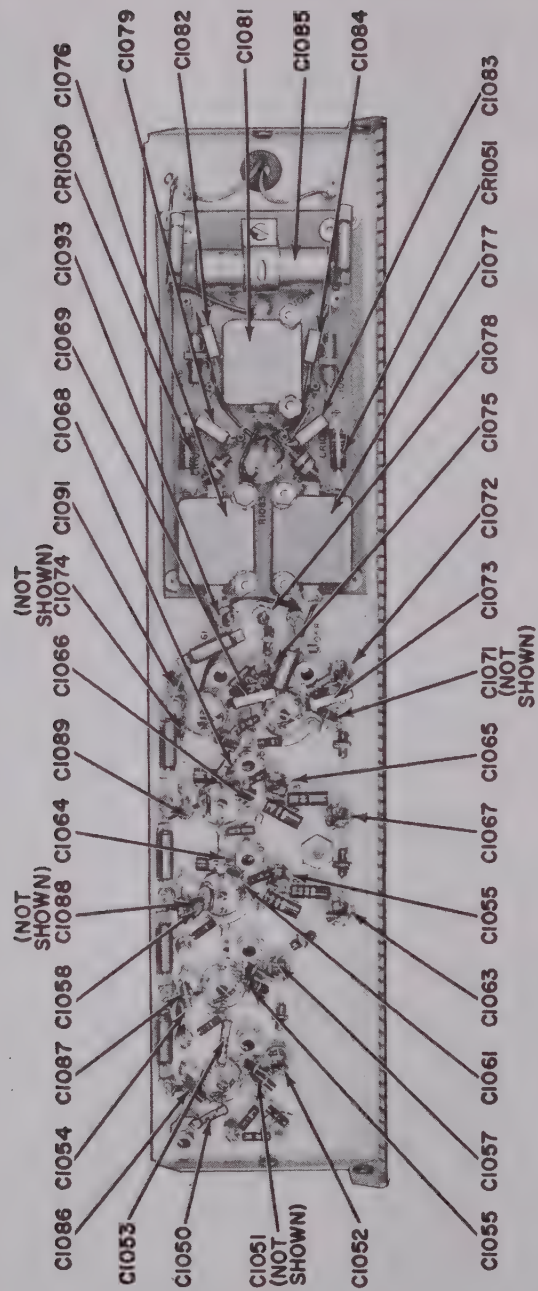


Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 2 of 4)

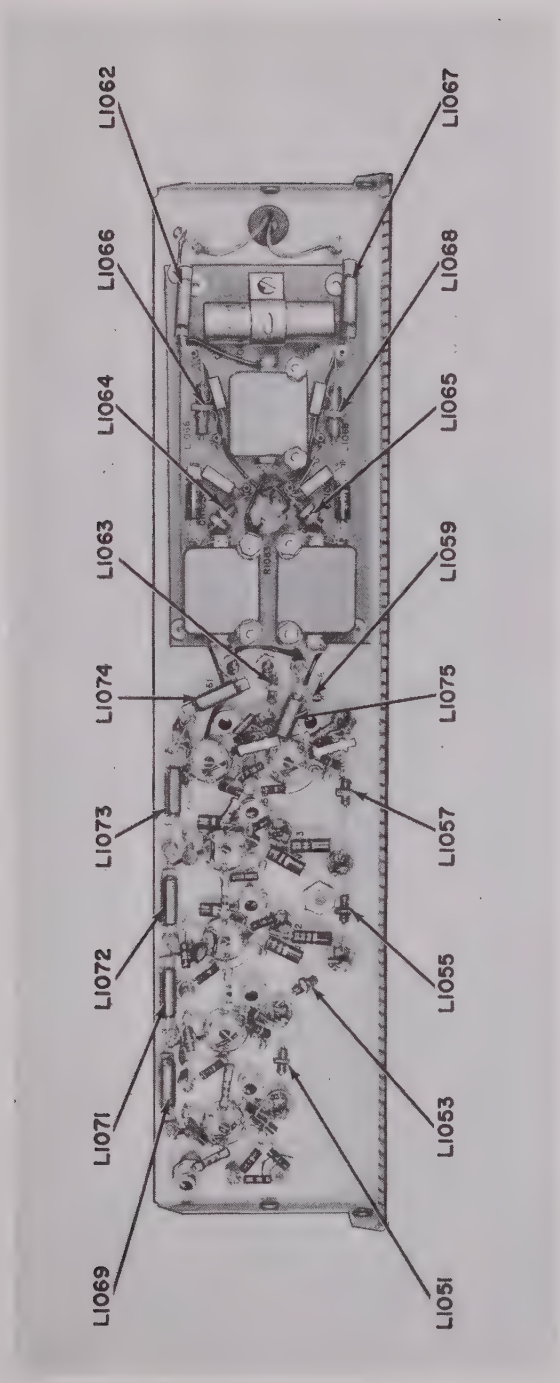


Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 3 of 4)

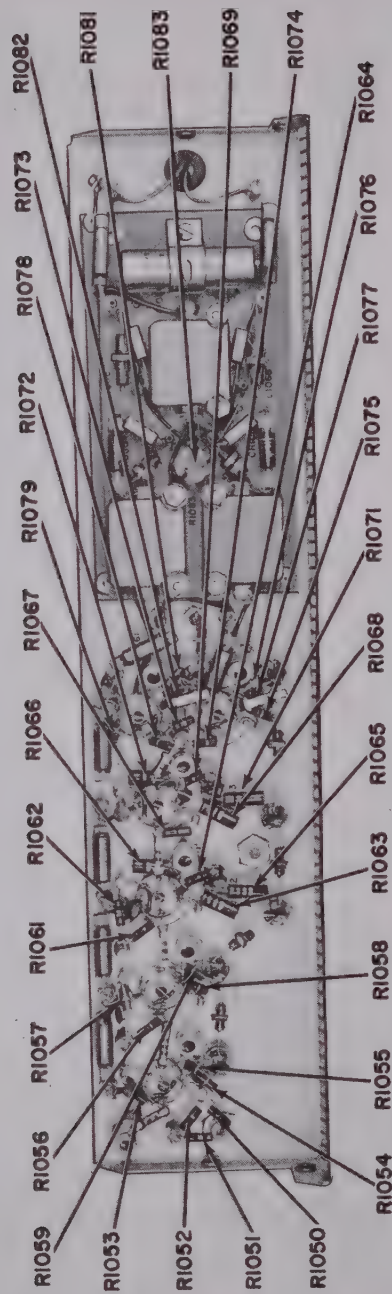


Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 4 of 4)

Table 4-11. Afc-I-f Amplifier, Voltage and Resistance Measurements

Socket	Tube Type	Pin Number						
		1	2	3	4	5	6	7
XV1050	6AU6	0	+1.15	6.3AC	0	+125	+125	+1.15
		2.2K	100	0.2	0	6.8K	6.8K	100
XV1051	6AU6	0	+1.2	6.3AC	0	+125	+125	+1.2
		5.5K	100	0.2	0	6.5K	6.5K	100
XV1052	6AK5	-0.1	0	6.3AC	0	+13.5	+42.5	0
		12K	0	0.2	0	34K	8.5K	0
XV1053	6AK5	-0.1	0	6.3AC	0	+16.5	+44	0
		15K	0	0.2	0	34K	8.5K	0
XV1054	6AU6	0	+1.15	0	6.3AC	+125	+125	+1.15
		4.7K	100	0	0.2	6.5K	6.5K	100
XV1055	6AU6	0	+1.15	0	6.3AC	+125	+125	+1.15
		4.7K	100	0	0.2	6.5K	6.5K	100

- NOTES: 1. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.
3. Voltage readings taken with P1051 removed from J104.

h. Connect the a-c probe of the vtm at the junction of resistors R1074 and R1078. The common probe should remain connected to chassis ground.

i. Adjust variable inductor L1056 to obtain maximum deflection of the vtm pointer.

j. Adjust Noise Balance control R1083 to mid-position.

k. Adjust the calibrated signal generator for an output of 50,000 microvolts at 41.75 mc.

l. Connect the positive probe of the vtm, which has been adjusted for +dc, to pin A of P1051. The common probe should be connected to pin D.

m. Adjust variable inductor L1061 to obtain maximum deflection of the vtm pointer.

n. Adjust the calibrated signal generator for 50,000 microvolts at 38.25 mc.

o. Set the vtm for -dc.

p. Adjust variable inductor L1058 to obtain maximum deflection of the vtm pointer.

q. Adjust the calibrated signal generator for a 50,000 microvolt output at 40 mc.

r. Adjust Noise Balance control R1083 to obtain a vtm pointer deflection of 0 volts.

s. Vary the output frequency of the calibrated signal generator over the range from 38.25 mc to 41.75 mc, maintaining its output level constant at 50,000 microvolts. With the vtvm, adjusted for +dc, connected to P1051, the d-c error signal output as a function of frequency shown in figure 4-24 should be obtained.

NOTE:

Zero volts should fall at the 40-mc mark, and the values of +3.5 volts (+ 0.25 volts) and -3.5 volts ($\pm$ 0.25 volt) should fall at 41.75 and 38.25 mc, respectively. If the above values cannot be obtained, V1054, V1055, and/or CR1050 and CR1051 should be replaced and the entire afc-i-f amplifier alignment procedure repeated.

4-57. After the afc-i-f amplifier has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 4-52, steps a through g.

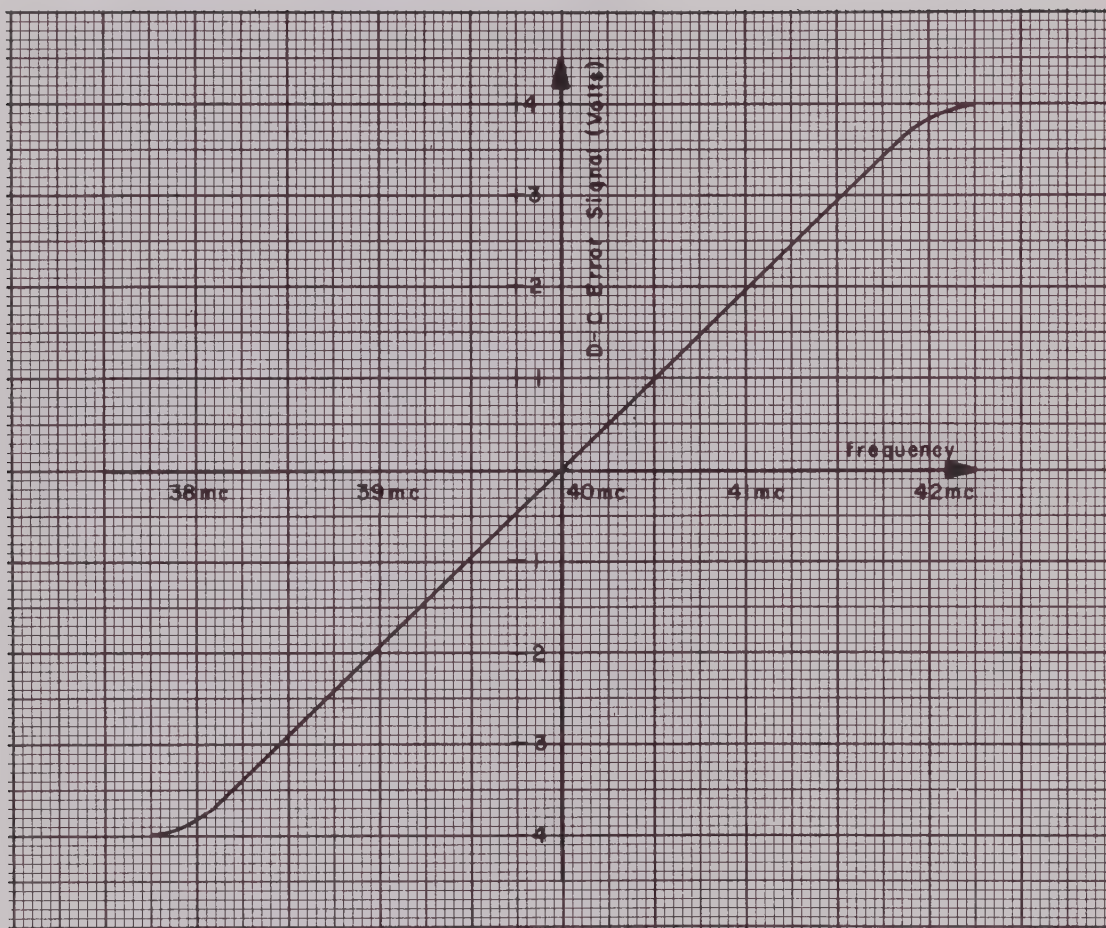


Figure 4-24. Afc-I-f Amplifier D-c Error Signal Output as a Function of Input Frequency

4-58. AFC AMPLIFIER, TROUBLESHOOTING.

4-59. To determine if the afc amplifier is operating properly, proceed as outlined in paragraph 2-7, steps a through al. Then proceed as outlined in the following steps.

a. With the AFC switch still in the OUT position, detune the microwave signal generator 5 mc either side of the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

b. Note the output meter pointer deflection. It should decrease.

c. Set the AFC switch to IN.

d. Note the output meter pointer deflection. It should be the same as that of paragraph 2-7, step al. If it is not, the afc amplifier, located in the high-voltage power supply, is defective. A defect within the afc amplifier circuitry can be localized with the aid of the voltage and resistance measurements supplied in table 4-12, the component location diagrams of the high-voltage power supply supplied in figures 4-5 through 4-8, and the schematic diagram of the high-voltage power supply supplied in figure 5-7.

4-60. AFC AMPLIFIER, ALIGNMENT.

4-61. To align the afc amplifier, proceed as outlined in the following steps.

a. With the POWER switch set to OFF, remove the Tuning Unit from the Basic Unit.

b. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit.

c. Set the AFC switch to OUT.

Table 4-12. Afc Amplifier, Voltage and Resistance Measurements

Socket	Tube Type	Pin Numbers						
		1	2	3	4	5	6	7
XV209 ^{3,6}	6AH6	-1100 Inf.	-1150 Inf.	-1150 Inf.	-1150 Inf.	-1100 Inf.	-900 80K	-1150 Inf. Volts Ohms
XV209 ^{4,6}	6AH6	-1650 Inf.	-1680 Inf.	-1680 Inf.	-1680 Inf.	-1650 Inf.	-1550 110K	-1680 Inf. Volts Ohms
XV209 ^{5,6}	6AH6	-1900 Inf.	-1950 Inf.	-1950 Inf.	-1950 Inf.	-1900 Inf.	-1800 135K	-1950 Inf. Volts Ohms

Notes:

1. Voltage readings taken with a 20,000 ohm-per-volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.
3. FIM-I2 or FIM-S2 Tuning Unit in use.
4. FIM-M2 Tuning Unit in use.
5. FIM-X2 Tuning Unit in use.
6. AFC switch set to IN.

d. Disconnect the jumper between pins 5 and 6 of terminal board assembly TB401, TB501, TB601, or TB701 (depending on the Tuning Unit in use).

e. Connect the positive probe of a d-c milliammeter to pin 5 of the terminal board assembly. Connect the common probe to pin 6.

f. Adjust the milliammeter for 10 ma full-scale deflection.

g. Set the POWER switch to ON. Allow the FIM-2 to stabilize for at least 15 minutes.

h. Rotate the TUNING control to the low end of the band.

i. Adjust Low I Adjust control R424 or R743 (for the Models FIM-L2 or FIM-X2 Tuning Units, respectively) or I Adjust control R524 or R624 (for the Models FIM-S2 or FIM-M2 Tuning Units, respectively) to obtain a milliammeter pointer deflection of 7 ma.

NOTE:

Repeat the above for the TUNING control rotated to the high end of the band (for the Models FIM-L2 and FIM-X2 Tuning Units only), adjusting High I Adjust control R425 or R766, respectively, to obtain a milliammeter deflection of 7 ma.

j. Set the POWER switch to OFF.

k. Remove the milliammeter and replace the jumper between pins 5 and 6 of the terminal board assembly.

l. Set the POWER switch to ON. Allow the FIM-2 to stabilize.

m. Set Test Selector switch S351 to L.O. Refl.

n. Note the deflection of the power monitor meter pointer. It should deflect to an indication within the green region of the scale.

o. Set the AFC switch to IN.

p. Note the power monitor meter pointer deflection.

It should remain at an indication within the green region of the scale. If it does not, adjust Afc Adjust control R251 to obtain the exact deflection as in step n, above.

4-62. LOCALIZING R-F TROUBLE TO AN INDIVIDUAL SUBASSEMBLY.

4-63. If the results of paragraph 4-12 indicated that the trouble lies in the r-f circuitry, proceed as outlined in table 4-13 to localize the r-f trouble to an individual r-f subassembly within either the Basic Unit or the Tuning Unit. Figure 4-25 will be of aid in locating the Tuning Unit subassemblies, components, and cables, while figures 4-10 and 4-11 will aid in locating the Basic Unit subassemblies, components, and cables.

TABLE 4-13. R-F CIRCUITRY TROUBLESHOOTING PROCEDURE

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
1	Visual	None	Set FUNCTION SEL switch to OPERATE. Connect i-f cable assembly W1204 between MIXER OUT and IF IN jacks. Set Test Selector switch S351 to Xtal Cur. Rotate TUNING control throughout band.	Power monitor meter pointer deflects smoothly over scale as TUNING control is rotated throughout the band.	First crystal mixer and first local oscillator are functioning properly. Proceed to step 2.	First crystal mixer defective. Refer to paragraph 4-59. First local oscillator defective. Refer to paragraph 4-61. Low-pass filter FL-402 (Model FIM-L2 Tuning Unit only) defective. Refer to paragraph 4-98.
2	Visual	None	Set Test Selector switch S351 to Operate. Set FUNCTION SEL switch to ZERO SET. Adjust power monitor meter ZERO SET control to obtain power monitor meter pointer indication of ZERO.	Power monitor meter pointer deflects to an indication of ZERO.	Signal calibrator power set probe and thermistor bridge functioning properly. Proceed to step 3.	Signal calibrator thermistor probe and/or thermistor bridge defective. Refer to paragraph 4-74.
3	Visual	None	Set FUNCTION SEL switch to CAL SIG GEN. Adjust SIGNAL CALIBRATOR POWER SET control to obtain power monitor meter pointer deflection corresponding to "Cal," as indicated on correction curves supplied with the Tuning Unit under test.	Power monitor meter pointer deflects to an indication corresponding to "cal."	Signal calibrator functioning properly. Proceed to step 4.	Signal calibrator defective. Refer to paragraph 4-84.
4	Visual	Microwave signal generator	Set FUNCTION SEL switch to OPERATE. Rotate IF GAIN control fully counterclockwise. Remove all i-f attenuation. Connect the microwave signal generator, tuned to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial and adjusted for an output of 1,000 microvolt, to the PRESEL in jack. Set the OUTPUT switch to ZERO SET.	Output meter pointer deflects to an indication of 1,000 on the RF uV scale.	Preselector functioning properly. Proceed to step 5.	Preselector not aligned. Refer to paragraph 4-92. Low-pass filter FL401 or FL501 (Model FIM-L2 or FIM-S2 Tuning Units respectively) defective. Refer to paragraph 4-98.

TABLE 4-13. R-F CIRCUITRY TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
4	(Cont'd)		Adjust the output meter ZERO SET control to zero-set the output meter. Set the OUTPUT switch to AVERAGE. Adjust the IF GAIN control to obtain an output meter pointer indication of 1,000 on the RF uV scale.			
5	Visual	None	Set FUNCTION SEL switch to CAL SIG GEN. Rotate SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counter-clockwise. Connect r-f cable assembly W1203 between the SIG GEN OUT and PRESEL IN jacks. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 1,000 on the RF uV scale.	Output meter pointer deflects to an indication of 1,000 on the RF uV scale.	Signal calibrator output attenuator probe functioning properly. Proceed to step 6.	Signal calibrator output attenuator probe defective. Refer to paragraph 4-102.
6	Visual	Microwave signal generator	Connect the microwave signal generator, tuned to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial and adjusted for an output of 1,000 microvolt, to the CAL IN jack. Connect r-f cable assembly W1203 between the ATTEN OUT and PRESEL IN jacks. Depress the r-f INPUT ATTENUATOR DB push-button switch marked 0X1.	Output meter pointer deflects to an indication of approximately 1,000 on the RF uV scale.	Coaxial r-f input attenuator assembly and coaxial r-f transfer switch functioning properly.	Coaxial r-f input attenuator assembly defective. Refer to paragraph 4-108. Coaxial r-f transfer switch defective. Refer to paragraph 4-108.
7	Visual	Microwave signal generator.	Depress the r-f INPUT ATTENUATOR DB push-button switch marked 20x10. Adjust the microwave signal generator for an output of 10,000 microvolts.	Same as step 6.	Same as step 6. Proceed to step 8.	Same as step 6.

TABLE 4-13. R-F CIRCUITRY TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
8	Visual	Microwave signal generator	Depress the r-f INPUT ATTENUATOR DB push-button switch marked 40x100. Adjust the microwave signal generator for an output of 100,000 microvolts.	Same as step 6.	Same as step 6.	Same as step 6
9	Visual	Microwave signal generator	Depress the r-f INPUT ATTENUATOR DB push-button switch marked 60x1000. Adjust the microwave signal generator for an output of 0.223 volts (0 dbm.)	Output meter pointer deflects to an indication of approximately 200 on the RF uV scale.	Same as step 6	Same as step 6
10	Visual	Microwave signal generator	Connect microwave signal generator to the RF IN jack. Set the FUNCTION SEL switch to OPERATE.	Same as step 9	Same as step 6	Same as step 6.

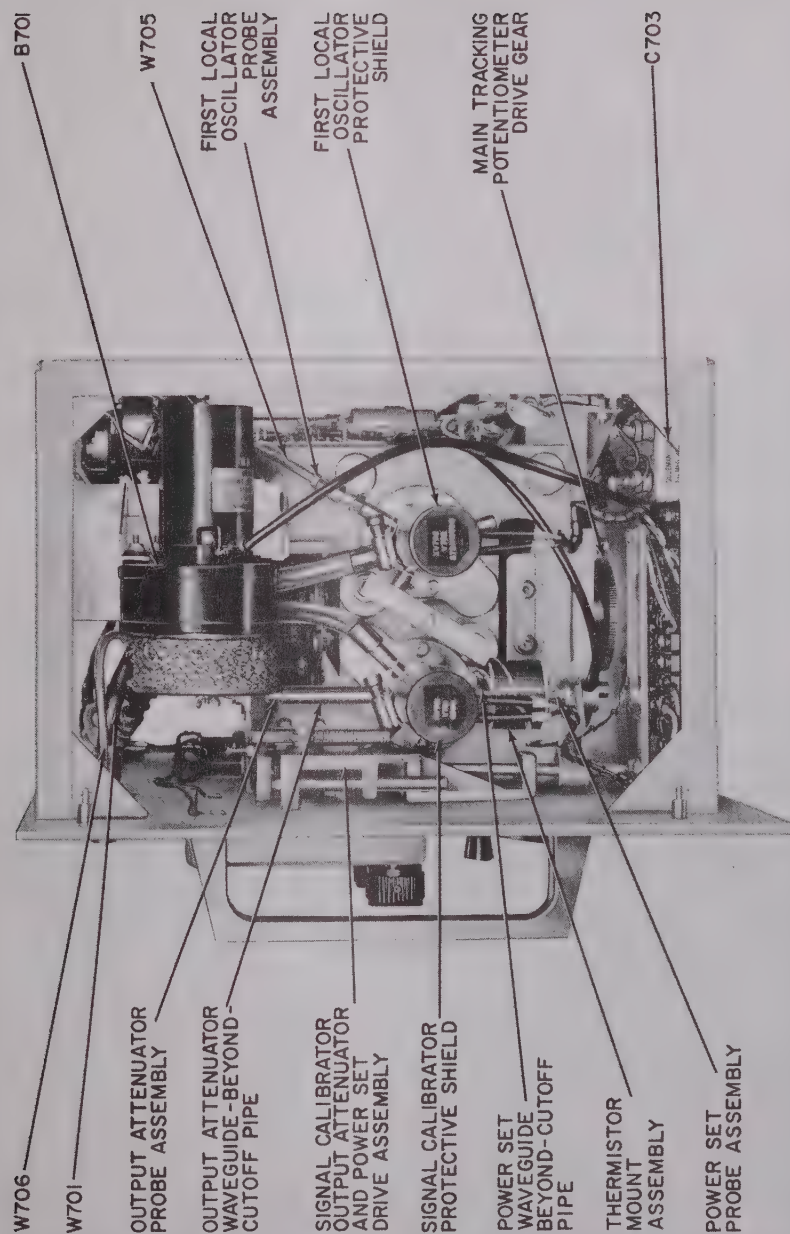


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component
Location Diagram (Sheet 1 of 5)

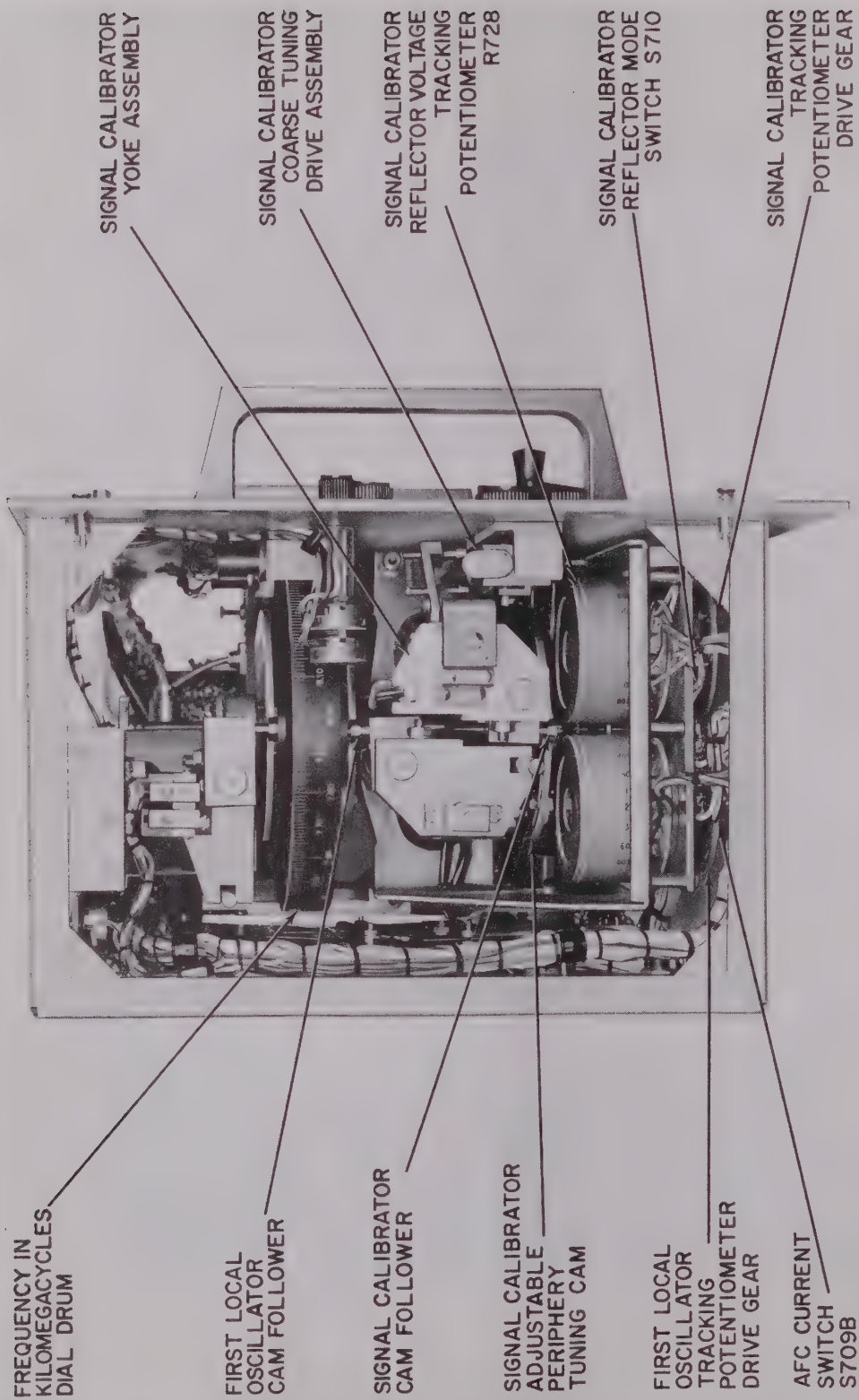


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component
Location Diagram (Sheet 2 of 5)

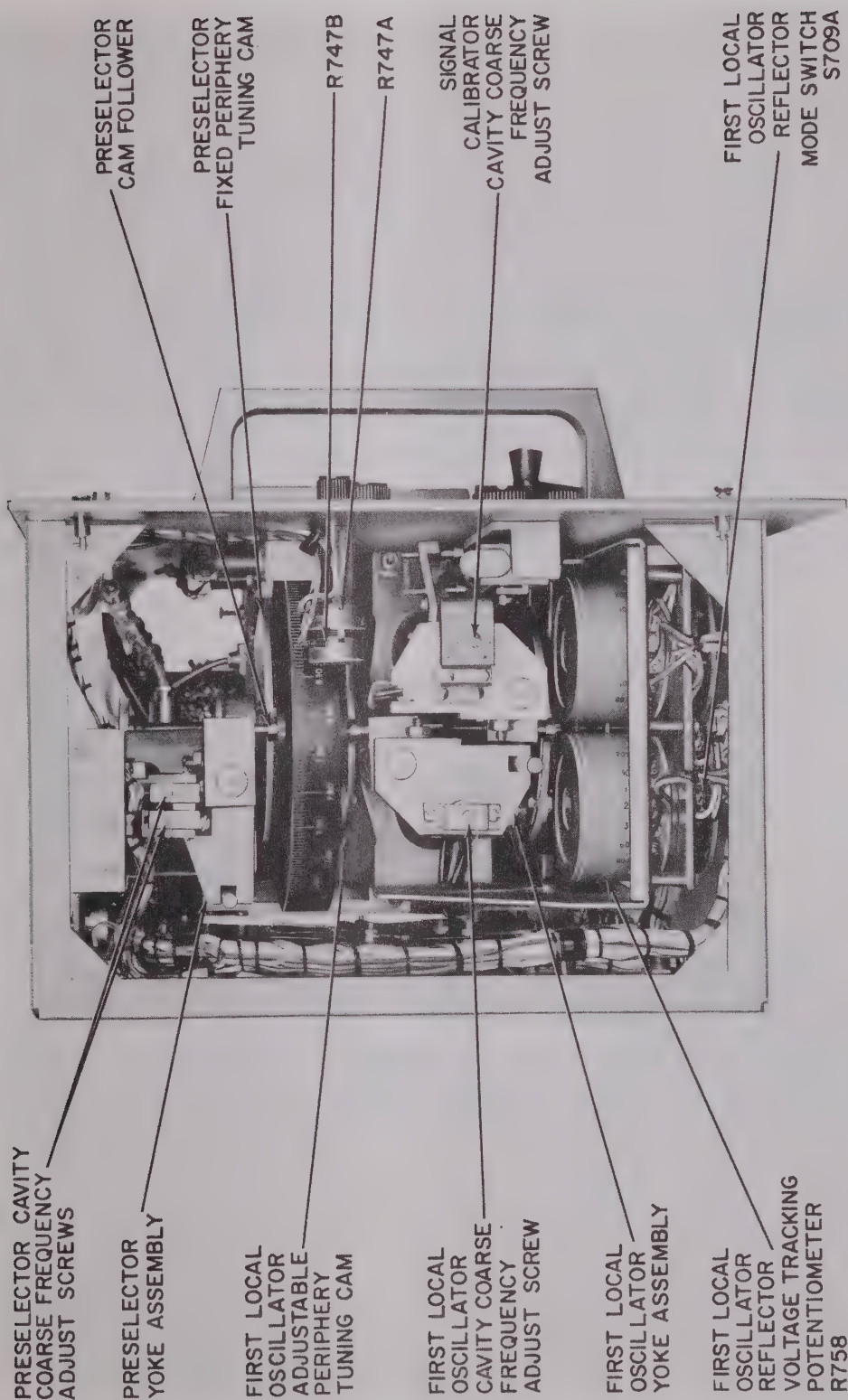


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 3 of 5)

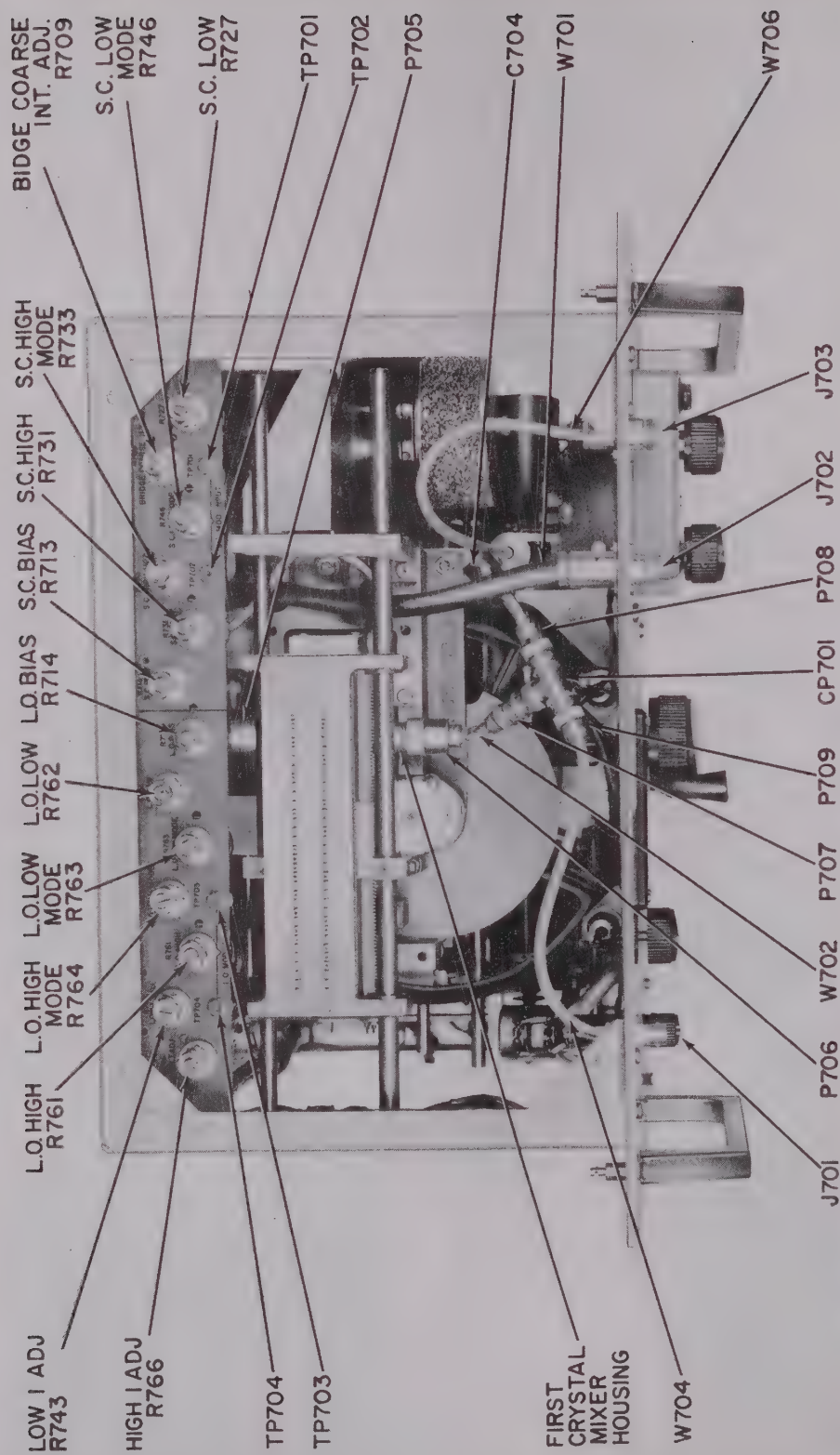


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 4 of 5)

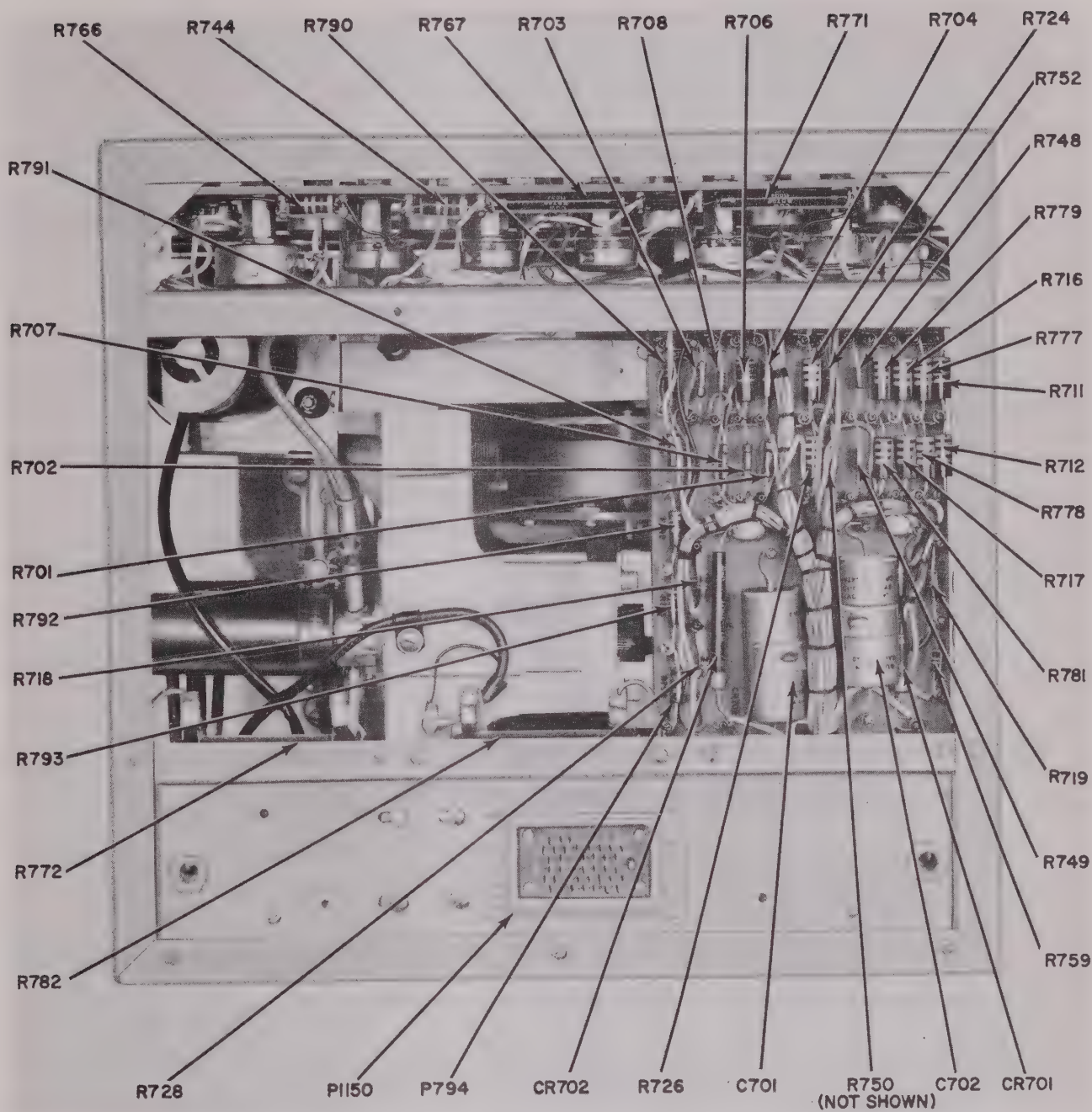


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 5 of 5)

4-64. FIRST CRYSTAL MIXER, REPLACEMENT.

4-65. To replace the first crystal mixer, proceed as outlined in the following steps.

a. Disconnect P406, P506, P606, or P706, depending upon the Tuning Unit being repaired, from the first crystal mixer housing connector.

b. Remove the defective crystal.

c. Replace the defective crystal with an appropriate operative crystal, as listed below in table 4-14.

TABLE 4-14. FIRST CRYSTAL MIXER TYPES.

Tuning Unit	First Crystal Mixer Reference Symbol Number	First Crystal Mixer Type
Model FIM-L2	CR403	1N23C
Model FIM-S2	CR503	1N23C
Model FIM-M2	CR603	1N23C
Model FIM-X2	CR603	1N2510

a. Reconnect P406, P506, P606, or P706, as applicable, to the first crystal mixer housing connector.

4-66. FIRST LOCAL OSCILLATOR, TUBE REPLACEMENT.

4-67. The reflex klystrons employed as the first local oscillators (V402, V502, V602, and V702) are seated within the right end of the first local oscillator external resonant cavity, when viewed from the front of the Tuning Unit. The protruding base of the tube is covered by a protective shield, on which the tube type, tube reference symbol number, and tube socket reference symbol number are screened.

4-68. MODEL FIM-L2 AND FIM-S2 TUNING UNITS. In replacement of the first local oscillator reflex klystron of these Tuning Units is necessary, proceed as outlined in the following steps.

WARNING:

HIGH VOLTAGES EXIST AT THE BASE CONNECTORS OF THE REFLEX KLYSTRON. BE SURE THAT THE FIM-2 IS UNENERGIZED BEFORE ATTEMPTING TO REPLACE THE FIRST LOCAL OSCILLATOR TUBE.

- a. Disconnect electrical power cable assembly W1201 from Basic Unit Power Input receptacle J100.
- b. With the Tuning Unit withdrawn from the Basic Unit, locate the first local oscillator protective shield.
- c. Loosen the single clamp screw that secures the protective shield to the knurled first local oscillator external resonant cavity end collar.
- d. Carefully remove the protective shield. The knurled end collar, tube socket, and base of the reflex klystron will now be visible and accessible.
- e. Carefully remove the socket from the base connectors of the reflex klystron.
- f. Place klystron wrench H1204 over the protruding portion of the reflex klystron. Move the wrench forward until contact is made with the knurled end collar. Rotate the klystron wrench to engage its pins with the holes in the end collar.
- g. Gently, but with pressure if necessary, rotate the klystron wrench counterclockwise to loosen the end collar.
- h. Remove the klystron wrench.
- i. Rotate the end collar by hand and remove it from the end of the external resonant cavity. The base of the reflex klystron can

now be easily gripped.

j. Grasp the protruding portion of the tube and, with a clockwise twisting motion, slowly withdraw it from the cavity.

NOTE:

Should the toroidal spring and spacing washer, which are contained within the cavity, come out as the tube is withdrawn, be sure to reinsert them before inserting the replacement reflex klystron. The toroidal spring is to be inserted first, followed by the spacing washer.

k. Insert the replacement reflex klystron into the cavity, applying a clockwise twisting motion to the base of the tube as it enters the cavity. A slight but noticeable resistance will be felt as the reflex klystron contact ring engages the toroidal spring. Continue twisting the tube, while simultaneously pressing it further into the cavity, until a positive stop is obtained. At this point the tube is properly seated within the cavity.

l. Replace the knurled end collar on the end of the cavity and hand-tighten the collar.

m. Place klystron wrench H1204 over the protruding portion of the tube. Move the wrench toward the knurled end collar until contact is made between the two. Rotate the wrench to engage its pins with the holes in the end collar.

n. Firmly tighten the end collar by rotating the klystron wrench counterclockwise.

o. Remove the klystron wrench.

CAUTION:

NEVER USE FORCE WHEN MATING THE SOCKET TO THE BASE CONNECTORS OF THE REPLACEMENT REFLEX KLYSTRON. SINCE IT IS POSSIBLE TO MATE THE SOCKET IN A MIS-ALIGNED POSITION, FORCED MATING OF THE SOCKET WILL RESULT IN PERMANENT DAMAGE TO THE REFLEX KLYSTRON UPON APPLICATION OF OPERATING POWER. OBSERVE THE MARKINGS ON BOTH THE BASE OF THE TUBE AND THE SOCKET. OBSERVE THESE MARKINGS WHEN MATING THE SOCKET TO THE TUBE.

p. Mate the socket to the base connectors of the replacement reflex klystron.

q. Replace the protective shield over the protruding portion of the replacement tube so that the open end of the shield covers the knurled end collar.

r. Tighten the single clamp screw that secures the protective shield to the end collar.

s. Rotate L.O. Opr Bias control R414 or R514, depending on the Tuning Unit being repaired, fully counterclockwise.

t. Proceed to paragraph 4-70.

4-64. MODEL FIM-M2 AND FIM-X2 TUNING UNITS. If replacement of the first local oscillator reflex klystron of these Tuning Units is necessary, proceed as outlined in the following steps.

WARNING:

HIGH VOLTAGES EXIST AT THE BASE CONNECTORS OF THE REFLEX KLYSTRON. BE SURE THAT THE FIM-2 IS UNENERGIZED BEFORE ATTEMPTING TO REPLACE THE FIRST LOCAL OSCILLATOR TUBE.

a. Disconnect electrical power cable assembly W1201 from Basic Unit Power Input receptacle J100.

b. Locate the first local oscillator protective shield.

c. Loosen the single clamp screw that secures the protective shield to the knurled first local oscillator external resonant cavity

end collar.

d. Carefully remove the protective shield. The first local oscillator reflex klystron tube base, socket, and knurled end collar will now be visible and accessible.

e. Carefully remove the socket from the base of the reflex klystron.

f. Place klystron wrench H1205 over the protruding portion of the reflex klystron. Move the wrench forward until it makes contact with the knurled end collar. Rotate the wrench to engage its pins with the holes in the end collar.

NOTE:

Do not remove the end collar from the cavity.

g. Gently, but using pressure if necessary, rotate the klystron wrench counterclockwise to loosen the end collar. Since the base of the reflex klystron protrudes well beyond the knurled end collar, removal of the latter from the cavity is not required.

h. Remove the klystron wrench.

i. Grasp the protruding portion of the reflex klystron and, with a clockwise twisting motion, slowly withdraw it from the cavity.

j. Insert a replacement reflex klystron into the cavity, using a clockwise twisting motion as the tube enters the cavity. Two slight but distinct resistances will be encountered as the reflex klystron contact ring engages the toroidal springs contained within the cavity. Continue twisting the tube, while simultaneously pressing

it further into the cavity, until the tube meets a positive stop. At this point the tube is properly seated within the cavity.

k. Replace the klystron wrench over the protruding portion of the tube. Move the wrench toward the end collar until contact is made between the two. Rotate the klystron wrench to engage its pins with the holes in the end collar.

l. Firmly tighten the knurled end collar by rotating the klystron wrench clockwise.

m. Remove the klystron wrench.

CAUTION:

NEVER USE FORCE WHEN MATING THE SOCKET TO THE BASE CONNECTORS OF THE REPLACEMENT REFLEX KLYSTRON. SINCE IT IS POSSIBLE TO MATE THE SOCKET IN A MIS-ALIGNED POSITION, FORCED MATING OF THE SOCKET WILL RESULT IN PERMANENT DAMAGE TO THE REFLEX KLYSTRON UPON APPLICATION OF OPERATING POWER. OBSERVE THE MARKINGS ON BOTH THE BASE OF THE TUBE AND THE SOCKET. OBSERVE THESE MARKINGS WHEN MATING THE SOCKET TO THE TUBE.

n. Mate the tube socket to the base connectors of the replacement reflex klystron.

o. Replace the protective shield over the protruding portion of the tube so that the open end of the shield covers the knurled end collar.

p. Tighten the single clamp screw that secures the protective shield to the knurled end collar.

q. Rotate L.O. Opr Bias control R614 or R714, depending on the Tuning Unit being repaired, fully counterclockwise.

r. Proceed to paragraph 4-70.

4-70. FIRST LOCAL OSCILLATOR, REFLECTOR VOLTAGE TRACKING.

4-71. Due to variations in reflex klystron tube characteristics, the replacement of the first local oscillator will necessitate re-tracking of the reflex klystron reflector voltage. The procedure for tracking the reflector voltage for the Model FIM-L2 and FIM-X2 Tuning Units, which employ mode switching, is outlined in paragraph 4-72; that for the Model FIM-S2 and FIM-M2 Tuning Units, which do not employ mode switching, is outlined in paragraph 4-73.

4-72. MODEL FIM-L2 AND FIM-X2 TUNING UNITS. To retrack the first local oscillator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applied to the Model FIM-L2 Tuning Unit, and immediately follows the information applying to the Model FIM-X2 Tuning Unit.

a. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.

b. Disconnect P706 (p406) from the first crystal mixer housing connector.

c. Remove first crystal mixer CR703 (CR403), inserting in its place a dummy crystal; one which has been purposely shorted by the removal of its detecting element and having its casing filled with solder.

d. Connect a length of RG-55/U coaxial cable between the first crystal mixer housing connector and the input connector of a frequency meter, as shown in figure 4-26.

e. Connect a crystal detector, having a d-c return, between the output connector of the frequency meter and the vertical input terminals of a high-gain oscilloscope, as shown in figure 4-26.

NOTES:

1. FXR Model N410A Frequency Meter used with Model FIM-L2 Tuning Unit.
FXR Model N410A and H410A Frequency Meters used with Model FIM-S2 Tuning Unit.
FXR Model H410A and C410A Frequency Meters used with Model FIM-M2 Tuning Unit.
FXR Model W410A Frequency Meter used with Model FIM-X2 Tuning Unit.
2. PRD Model 357 Waveguide-to-Coax Adapter used with FXR Model H410A Frequency Meter.
PRD Model 356A Waveguide-to-Coax Adapter used with FXR Model C410A Frequency Meter.
PRD Model 354B Waveguide-to-Coax Adapter used with FXR Model W410A Frequency Meter.

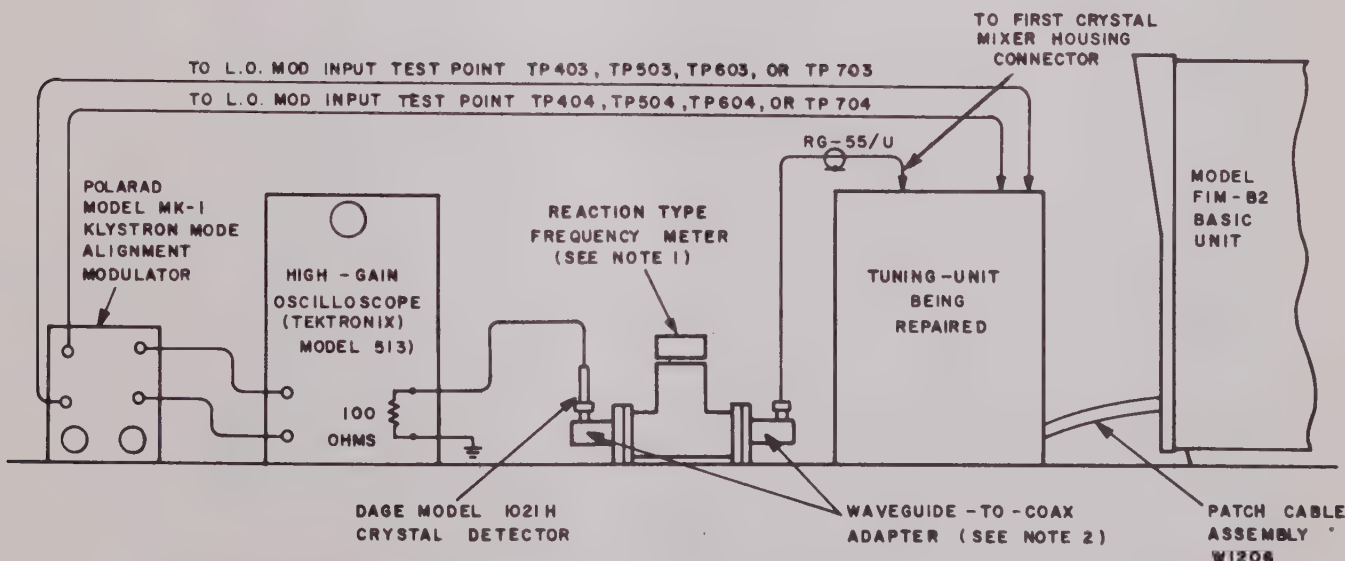


Figure 4-26. Tracking First Local Oscillator Reflector Voltage,
Equipment Set Up.

oscilloscope, as shown in figure 4-26.

f. Connect the "reflector" terminals of the Polarad Model MK-1 Klystron Mode Alignment Modulator to the Tuning Unit L.O. Mod Input test points, TP703 and TP704 (TP403 and TP404), as shown in figure 4-26. If the Model MK-1 is not available, an equivalent klystron modulator can be constructed with the aid of the schematic diagram supplied in figure 4-27.

g. Connect the horizontal input terminals of the high-gain oscilloscope to the Model MK-1 "h scope" and "ground" terminals, as shown in figure 4-26.

h. Set the POWER switch to OFF.

i. Connect patch cable assembly W1206 between P1150 of the Tuning Unit being repaired and J1150 of the Basic Unit, as shown in figure 4-26.

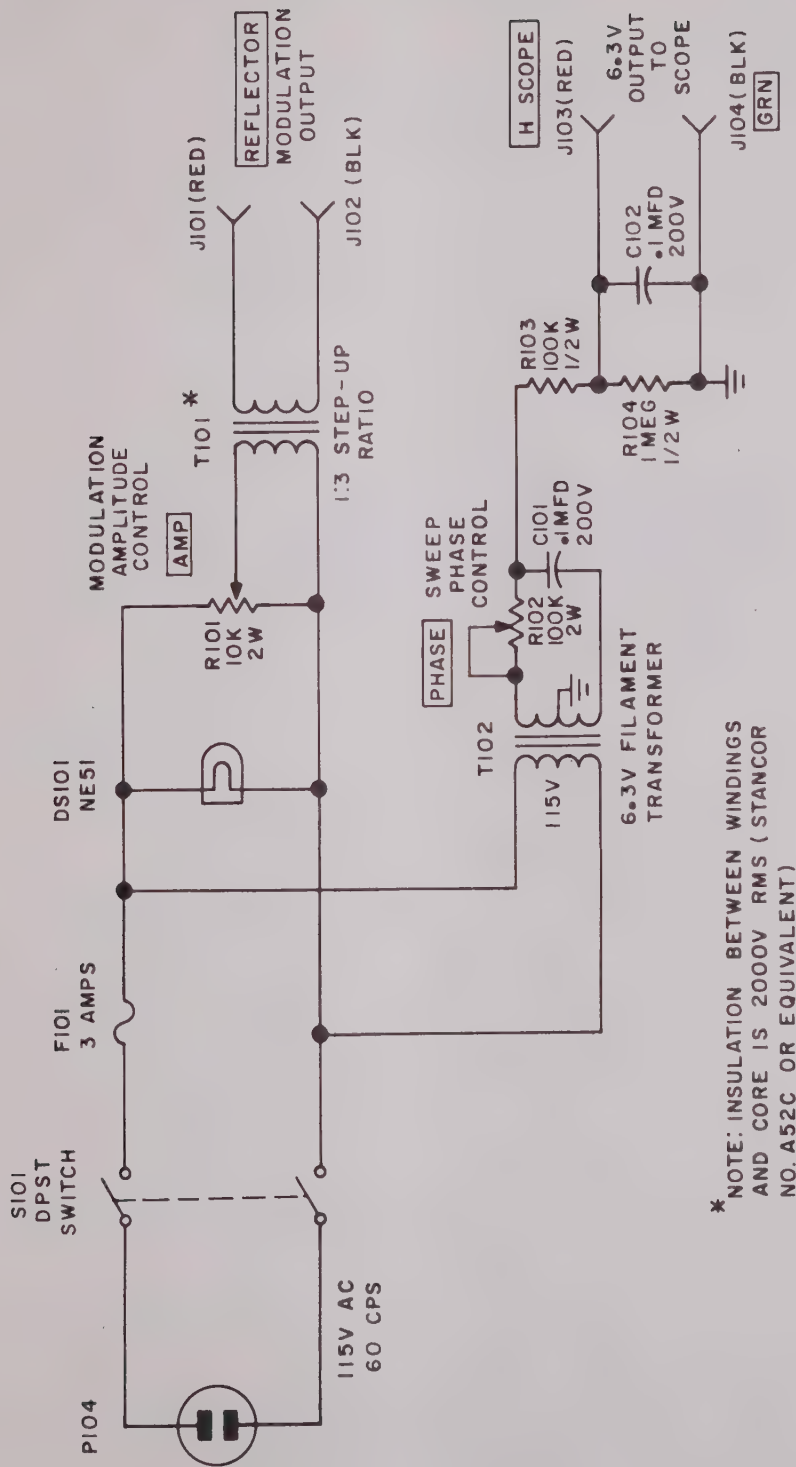
j. Apply operating power to the FIM-2.

k. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY lamp will light, indicating that the high-voltage power supply is energized. Allow the FIM-2 to stabilize for at least fifteen minutes.

l. Set Test Selector switch S351 (located on the meter adjust board) to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region will necessitate retracking of the signal calibrator reflector voltage. Refer to paragraph 4-90.



* NOTE: INSULATION BETWEEN WINDINGS
AND CORE IS 2000V RMS (STANCOR
NO. A52C OR EQUIVALENT)

Figure 4-27. Klystron Mode Alignment Modulator, Schematic Diagram

m. Adjust Refl Adjust control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the scale.

n. Set the FUNCTION SEL switch to OPERATE.

o. Set Test Selector switch S351 to Anode Ma.

p. Adjust L.O. Opr Bias control R714 (R414) to obtain a power monitor meter pointer deflection corresponding to figure 4-28 (figure 4-29).

NOTE:

In the Model FIM-X2 Tuning Unit, the first local oscillator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGA-CYCLES drum. In the Model FIM-L2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers

q. Rotate the TUNING control so that the first local oscillator cam follower is at the fixed point of the first local oscillator adjustable periphery tuning cam. (See figure 4-30.)

r. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope. If the mode pattern is not centered, as shown in figure 4-31a, or does not appear on the oscilloscope screen, proceed as outlined in the following additional steps.

1. Rotate the TUNING control to a point just above the mode switching point.

2. Center the mode pattern on the oscilloscope screen by adjusting L.O. High Mode control R764 (R464). (See figure 4-31b.)

3. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.

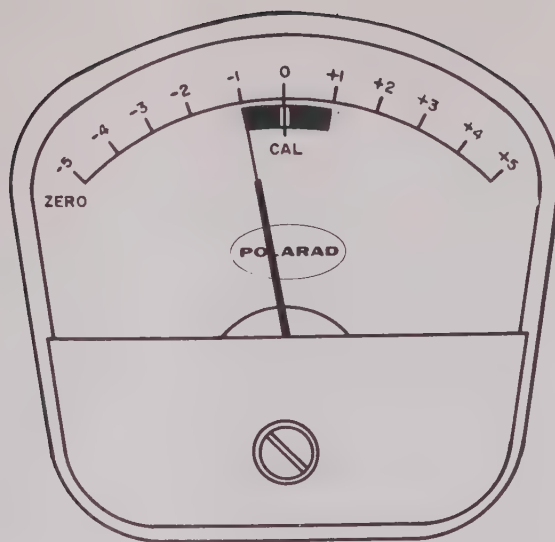


Figure 4-28. Power Monitor Meter Pointer Deflection
Corresponding to "Anode Ma" Set, Models FIM-X2
and FIM-M2 Tuning Units (FUNCTION SEL
Switch Set to OPERATE)

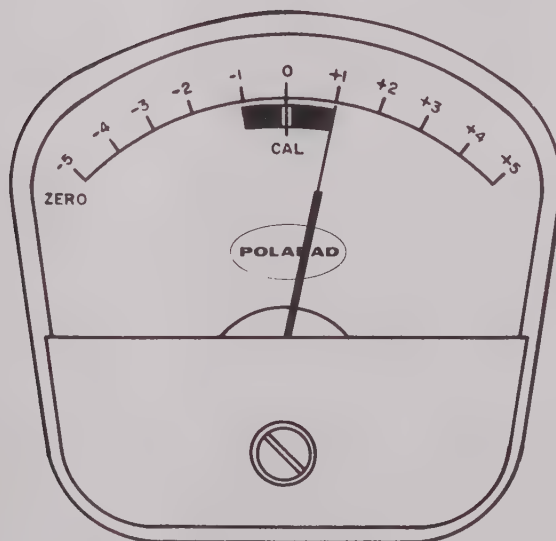


Figure 4-29. Power Monitor Meter Pointer Deflection
Corresponding to "Anode Ma" Set, Models FIM-L2
and FIM-S2 Tuning Units (FUNCTION SEL
Switch Set to OPERATE)

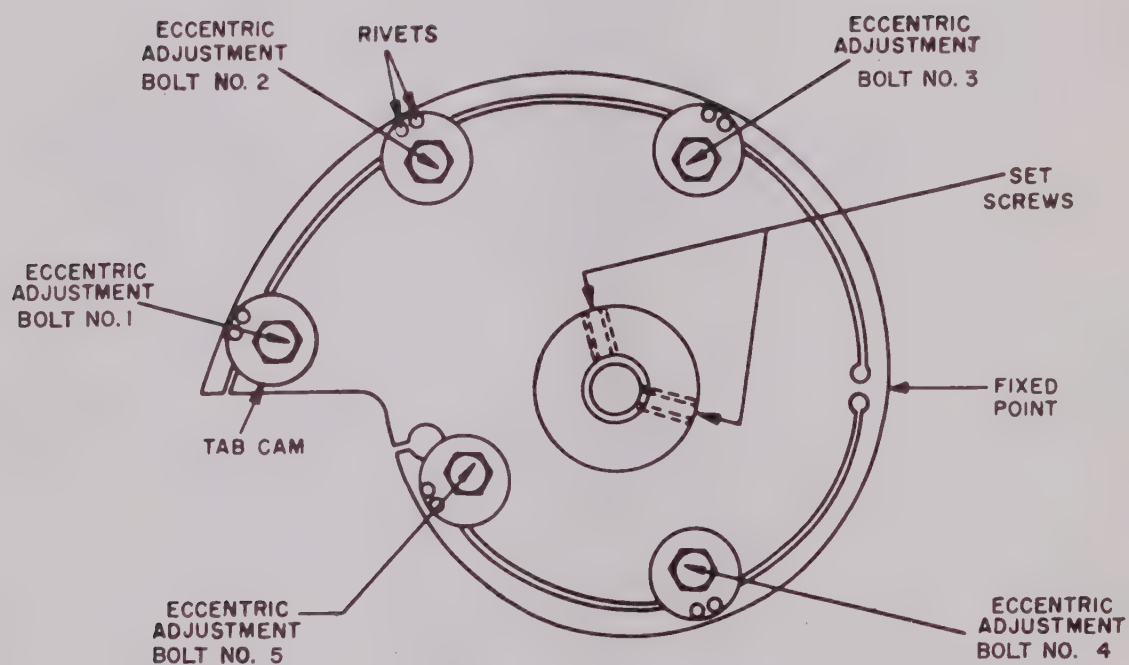
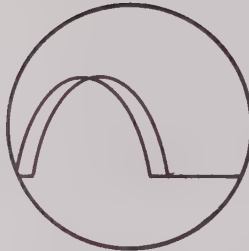
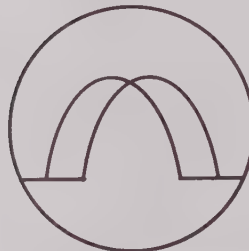


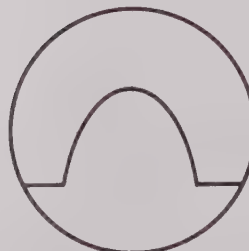
Figure 4-30. Typical Adjustable Periphery Tuning Cam



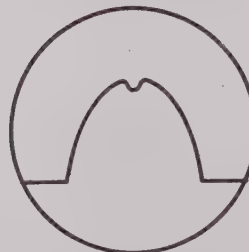
A. MODE PATTERN NOT CENTERED



B. MODE PATTERN CENTERED



C. MODE PATTERN REDUCED
TO SINGLE TRACE



D. DIP AT PEAK OF
MODE PATTERN

Figure 4-31. Typical Mode Pattern Displays

4. Connect the positive probe of a d-c vtvm to pin 3 of TB701 (TB401). Connect the common probe to L.O. Mod Input test point TP703 (TP403).

5. Note the vtvm reading. A reading within the limits of 115 and 200 volts (75 and 125 volts) indicates that the reflex klystron is operating in the desired 4-3/4-wave (2-3/4-wave) reflector mode.

6. Rotate the TUNING control to a point just below the mode switching point.

7. Center the mode pattern on the oscilloscope screen by adjusting L.O. Low Mode control R763 (R463).

8. Note the vtvm reading. A reading within the limits of 275 and 360 volts (215 and 265 volts) indicates that the reflex klystron is operating within the desired 3-3/4-wave (1-3/4-wave) reflector mode.

9. Rotate the TUNING control to the high end of the band.

10. Center the mode pattern on the oscilloscope screen by adjusting L.O. High control R761 (R461).

11. Note the vtvm reading. A reading within the limits of 165 and 265 volts (255 and 305 volts) indicates that the reflex klystron is operating within the desired 4-3/4-wave (2-3/4-wave) reflector mode.

12. Rotate the TUNING control to the low end of the band.

13. Center the mode pattern on the oscilloscope screen by adjusting L.O. Low control R762 (R462).

14. Note the vtvm reading. A reading within the limits of 125 and 200 volts (140 and 190 volts) indicates that the reflex klystron is operating in the desired 3-3/4-wave (2-3/4-wave) reflector mode.

NOTE:

Due to some interaction between the above controls, it may be necessary to repeat the above steps for optimum setting of the controls throughout the frequency range of the Tuning Unit being repaired.

s. Remove the voltmeter.

t. Rotate the TUNING control from one end of the band to the other. Note the mode pattern displayed on the oscilloscope screen. The pattern should be continuous and display no splitting or loss of power at any point, and should remain centered on the oscilloscope screen.

NOTE:

If the displayed mode pattern is erratic at any point within the band, rotate the TUNING control to the point of discontinuity. Remove operating power from the FIM-2 and loosen the single clamp screw that secures the protective shield to the knurled end collar. Remove the protective shield and adjust spanner wrench H1206 so that it engages the holes in the knurled end collar. Loosen the end collar and gently twist the reflex klystron tube clockwise. Tighten the end collar and replace the protective shield. Reenergize the FIM-2 and rescan the band for continuity as outlined in step t, above.

Since the orientation of the reflex klystron tube within the first local oscillator external resonant cavity for optimum performance cannot be anticipated, it is suggested that the reflex klystron twisting operation be performed in 30-degree increments until continuity throughout the band is achieved.

u. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note

the FREQUENCY IN KILOMEGACYCLES dial indication.

v. Tune the frequency meter to a frequency 260 mc below (260 mc above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial.

w. Adjust the first local oscillator cavity coarse frequency adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode pattern, as shown in figure 4-31d.

x. Rotate the TUNING control so that the cam follower rests opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-30.)

y. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note the FREQUENCY IN KILOMEGACYCLES dial and frequency meter indications. The latter should be 260 mc $\pm 1\%$ below (260 mc $\pm 1\%$ above) the former.

z. Repeat steps x and y, above, for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter resonant frequency should be 260 mc $\pm 1\%$ below (260 mc $\pm 1\%$ above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial. If the frequency difference is greater than that specified, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL THE ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE FIRST BEEN LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING OF THE RIVETS THAT SECURE THE TABS TO THE ADJUSTABLE PERIPHERY OF THE TUNING CAM.

NOTE:

If the error occurs at the high end of the band, loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3. If the error occurs at the low end of the band, loosen, in order, eccentric adjustment bolts no. 4 and 5.

1. Rotate the TUNING control to position the cam follower opposite the fixed point of the adjustable periphery tuning cam.
2. Rotate the TUNING control toward the high end of the band or the low end, as necessary, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.
3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to a frequency 260 mc below (260 mc above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial.
4. Adjust the position of the adjustable periphery tuning cam tab so that the dip appears at the peak of the displayed mode pattern.
5. Tighten the eccentric adjustment bolt.
6. Repeat steps 3, 4, and 5, above, for the remaining eccentric adjustment bolts.
 - aa. Remove the leads from the L.O. Mod Input test points.
 - ab. Disconnect the length of RG-55/U coaxial cable from the first crystal mixer housing connector.
 - ac. Replace the dummy first crystal mixer with the operative first crystal mixer.
 - ad. Connect P706 (P406) to the first crystal mixer housing connector.
 - ae. Set Test Selector switch S351 to Xtal Cur.
 - af. Rotate the TUNING control throughout the band, noting the power monitor meter pointer. The power monitor meter pointer

should deflect smoothly over the scale as the TUNING control is rotated throughout the band.

NOTE:

Retracking of the first local oscillator reflector voltage will necessitate retracking of the preslector. Refer to paragraph 4-92.

4-73. MODELS FIM-S $\angle$ AND FIM-M $\angle$ TUNING UNITS. To retrack the first local oscillator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-S2 Tuning Unit, and immediately follows the information applying to the Model FIM-M $\angle$ Tunint Unit.

- a. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.
- b. Disconnect P606 (P506) from the first crystal mixer housing connector.
- c. Remove first crystal mixer CR603 (CR503), inserting in its place a dummy crystal; one which has been purposely shorted by the removal of its detecting element and having its casing filled with solder.
- d. Connect a length of RG-55/U coaxial cable between the first crystal mixer housing connector and the input connector of a frequency meter, as shown in figure 4-26.
- e. Connect a crystal detector, having a d-c return, between the output connector of the frequency meter and the vertical input terminals of a high-gain oscilloscope, as shown in figure 4-26.

f. Connect the "reflector" terminals of the Polarad Model MK-1 Klystron Mode Alignment Modulator (or equivalent, as shown in figure 4-27) to the Tuning Unit L.O. Mod Input test points, TP603 and TP604 (TP503 and TP504), as shown in figure 4-26.

g. Connect the horizontal input terminals of the high-gain oscilloscope to the Model MK-1 "h scope" terminals, as shown in figure 4-26.

h. Set the POWER switch to OFF.

i. Connect patch cable assembly W1206 between P1150 of the Tuning Unit being repaired and J1150 of the Basic Unit, as shown in figure 4-26.

j. Apply operating power to the FIM-2. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light, indicating that the high-voltage supply is energized. Allow the FIM-2 to stabilize for at least 15 minutes.

k. Set Test Selector switch S351 (located on the meter adjust board) to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region will necessitate retracking of the signal calibrator reflector voltage. Refer to paragraph 4-91.

l. Adjust Refl Adjust Control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the scale.

m. Set the FUNCTION SEL switch to OPERATE.

n. Set Test Selector switch S351 to Anode Ma.

o. Adjust L.O. Opr Bias control R614 (R514) to obtain a power monitor meter pointer deflection corresponding to figure 4-28

(figure 4-29).

NOTE:

In the Model FIM-M2 Tuning Unit, the first local oscillator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGACYCLES dial drum. In the Model FIM-S2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers.

p. Rotate the TUNING control so that the first local oscillator cam follower is at the fixed point of the adjustable periphery tuning cam. (See figure 4-30.)

q. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope screen, as shown in figure 4-31a. If the mode pattern is not centered, as shown in figure 4-31b, or does not appear on the oscilloscope screen, proceed as outlined in the following additional steps.

1. Rotate the TUNING control to the high end of the band.

2. Center the mode pattern on the oscilloscope screen by adjusting L.O. High control R661 (R561).

3. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.

4. Connect the positive probe of a d-c vtvm to pin 3 of TB601 (TB501). Connect the common probe to L.O. Mod Input test point TP603 (TP503).

5. Note the vtvm reading. A reading within the limits of 500 and 600 volts (250 and 345 volts) indicates that the reflex klystron is operating in the desired 2-3/4-wave (2-3/4-wave) reflector mode.

6. Rotate the TUNING control to the low end of the band.
7. Center the mode pattern on the oscilloscope screen by adjusting L.O. Low control R662 (R562).
8. Note the vtvm reading. A reading within the limits of 100 and 200 volts (20 and 60 volts) indicates that the reflex klystron is operating in the desired 3-3/4-wave (3-3/4-wave) reflector mode.

NOTE:

Due to some interaction between the above controls, it may be necessary to repeat the above steps for optimum setting of the controls throughout the frequency range of the Tuning Unit being repaired.

- r. Remove the voltmeter.
- s. Rotate the TUNING control from one end of the band to the other. Note the mode pattern displayed on the oscilloscope screen. The pattern should be continuous and display no splitting or loss of power at any point, and should remain centered on the oscilloscope screen.

NOTE:

If the displayed mode pattern is erratic at any point within the band, rotate the TUNING control to the point of discontinuity. Remove operating power from the FIM-2 and loosen the single clamp screw that secures the protective shield to the knurled end collar. Remove the protective shield and adjust spanner wrench H1206 so that it engages the holes in the knurled end collar. Loosen the end collar and gently twist the reflex klystron tube clockwise. Tighten the end collar and replace the protective shield. Re-energize the FIM-2 and rescan the band for discontinuities, as outlined in step s, above.

Since the orientation of the reflex klystron tube within the first local oscillator external resonant cavity for optimum performance cannot be anticipated, it is suggested that the reflex klystron twisting operation be performed in 30-degree increments until continuity throughout the band is achieved.

t. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

u. Tune the frequency meter to 260 mc above (260 mc above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial.

v. Adjust the first local oscillator cavity coarse frequency adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode pattern, as shown in figure 4-31d.

w. Rotate the TUNING control so that the cam follower rests opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-30.)

x. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note both the FREQUENCY IN KILOMEGACYCLES dial and frequency meter indications. The former should be 260 mc $\pm 1\%$ above (260 mc $\pm 1\%$ below) the latter.

y. Repeat steps w and x, above, for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter should be tuned to 260 mc above (260 mc above) the indication of the FREQUENCY IN KILOMEGACYCLES dial. If the frequency difference is outside the limits of 260 mc $\pm 1\%$, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL THE ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE FIRST BEEN LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING OF THE RIVETS THAT SECURE THE TABS TO THE ADJUSTABLE PERIPHERY OF THE TUNING CAM.

1. If the error occurs at the high end of the band,

loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3; if the error is at the low end of the band, loosen, in the order stated, eccentric adjustment bolts no. 4 and 5.

2. With the cam follower resting opposite the fixed point of the adjustable periphery tuning cam, rotate the TUNING control toward the high end of the band or the low end of the band, as required, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.

3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to 260 mc above (260 mc above) this indication.

4. Adjust the position of the adjustable periphery tuning cam tab until the dip appears at the peak of the displayed mode pattern.

5. Tighten the eccentric adjustment bolt.

6. Repeat steps 2 through 5, above, for the remaining eccentric adjustment bolts.

z. Remove the leads from the L.O. Mod Input test points.

aa. Disconnect the length of RG-55/U coaxial cable from the first crystal mixer housing connector.

ab. Replace the dummy crystal with the operative first crystal mixer.

ac. Connect P606 (P506) to the first crystal mixer housing connector.

ad. Set Test Selector switch S351 to Xtal Cur. Rotate the TUNING control throughout the band. The power monitor meter pointer should deflect smoothly over the scale as the TUNING control is rotated.

NOTE:

After the first local oscillator reflector voltage has been retracked, it will be necessary to retrack the preselector. Refer to paragraph 4-92.

4-74. THERMISTOR BRIDGE CIRCUIT, TROUBLESHOOTING.

4-75. If the power monitor meter deflects to either beyond a deflection of +5 or below a deflection of ZERO when the FUNCTION SEL switch is set to CAL SIG GEN and the Test Sel switch set to Opr, the thermistor bridge circuitry is defective. To replace the signal calibrator thermistor probe, proceed as outlined in paragraph 4-76; to replace the signal calibrator thermistor mount, proceed as outlined in paragraph 4-80.

4-76. SIGNAL CALIBRATOR THERMISTOR PROBE, REMOVAL.

4-77. To remove the signal calibrator thermistor probe from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

- a. With the POWER switch set to OFF and the Tuning Unit removed from the Basic Unit, unsolder the thermistor probe cable terminations on the external cavity support casting stand-off.

- b. Loosen and remove the single cable clamp that secures the probe cable to the casting. Place the clamp and its associated hardware in an accessible location.

- c. Loosen the two setscrews (1, figure 4-32) that secure the signal calibrator thermistor probe (2, figure 4-32) to the signal calibrator thermistor probe drive yoke (3, figure 4-32).

- d. Carefully withdraw the signal calibrator thermistor probe and signal calibrator thermistor probe drive yoke from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32) and the signal calibrator thermistor probe drive rod (5, figure 4-32), respectively.

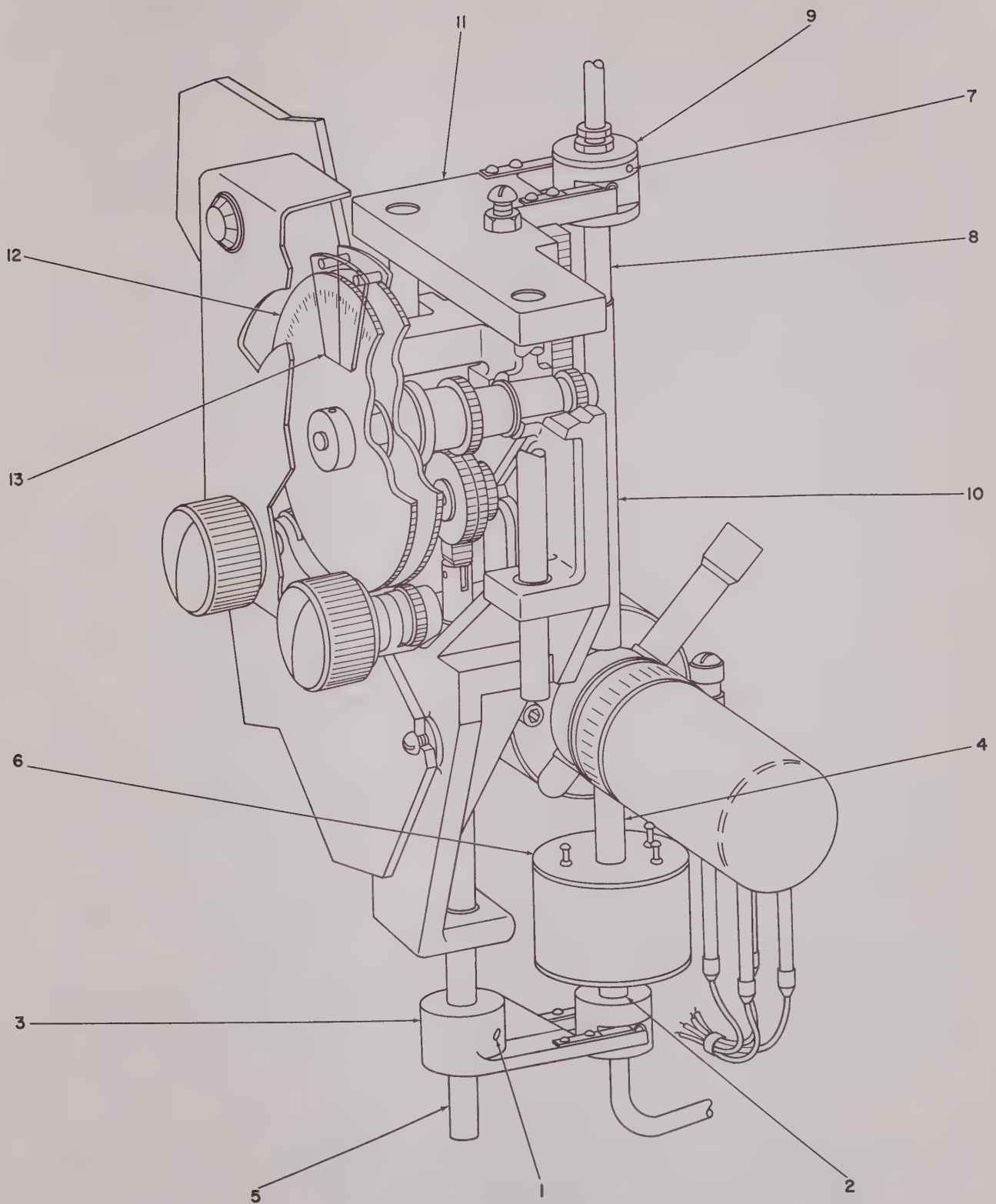


Figure 4-32. Signal Calibrator Power Set and Output Attenuator Drive Mechanism

e. Gently separate the signal calibrator thermistor probe and cable assembly from the signal calibrator thermistor probe drive yoke.

f. Place the signal calibrator thermistor probe drive yoke in an accessible location.

g. Proceed to paragraph 4-106.

4-78. SIGNAL CALIBRATOR THERMISTOR PROBE, REPLACEMENT.

4-79. To insert the replacement signal calibrator thermistor probe and yoke assembly into the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Carefully mate the replacement signal calibrator thermistor probe (2, figure 4-32) with the signal calibrator thermistor probe drive yoke (3, figure 4-32).

b. Carefully insert the tip of the signal calibrator thermistor probe into the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32).

c. Carefully slip the signal calibrator thermistor probe drive yoke (3, figure 4-32) over the signal calibrator thermistor probe drive rod (5, figure 4-32).

d. Adjust the position of the signal calibrator thermistor probe so that the line engraved on its barrel lines up with the line engraved on the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe.

e. Tighten the two setscrews on the signal calibrator thermistor probe drive yoke (1, figure 4-32), thereby securing the signal calibrator thermistor probe to the signal calibrator thermistor probe drive yoke.

f. Replace the thermistor probe cable clamp and resolder the thermistor probe cable to its termination on the external cavity support casting.

4-80. SIGNAL CALIBRATOR THERMISTOR MOUNT, REMOVAL.

4-81. To remove the signal calibrator thermistor mount from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Proceed as outlined in paragraph 4-76, steps a through d.

b. Loosen and remove the single screw that secures the thermistor mount cover plate to the signal calibrator thermistor mount (6, figure 4-32). Place the screw and its associated hardware in an accessible location.

c. Remove the thermistor mount cover plate.

d. Remove the tubular cover from the signal calibrator thermistor mount.

e. Loosen the two screws that secure the thermistor mount to the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32).

f. Remove the thermistor mount from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe.

g. Unsolder the wires terminating on the signal calibrator thermistor mount.

4-82. SIGNAL CALIBRATOR THERMISTOR MOUNT, REPLACEMENT.

4-83. To replace the signal calibrator thermistor mount on the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Slip the thermistor mount onto the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32).

b. Tighten the two thermistor mount screws, thereby securing the thermistor mount to the signal calibrator external cavity waveguide-beyond-cutoff attenuator pipe.

c. Replace the thermistor mount tubular cover.

d. Replace the thermistor mount cover plate.

e. Replace and tighten the single screw which secures the cover plate to the thermistor mount.

f. Resolder the leads to the thermistor mount.

g. Replace the thermistor probe, as outlined in paragraph 4-78, steps b through e.

h. Proceed to paragraph 4-106.

4-84. SIGNAL CALIBRATOR, TUBE REPLACEMENT.

4-85. The reflex klystrons employed as the signal calibrators V401, V501, V601, and V701 are partially seated within the right end of the signal calibrator external resonant cavity, as viewed from the front of the Tuning Unit. The signal calibrator reflex klystron, like the first local oscillator reflex klystron, has its protruding base covered by a protective shield, on which the tube reference symbol number, socket reference symbol number, and tube types are screened.

4-86 MODELS FIM-L2 AND FIM-S2 TUNING UNITS. If replacement of the signal calibrator reflex klystron of these Tuning Units is necessary, proceed as outlined in paragraph 4-68, substituting "signal calibrator" in place of "first local oscillator" and "S.C. Opr Bias control R413 or R513" in place of "L.O. Opr Bias control R414 or R514."

4-87. MODELS FIM-M2 AND FIM-X2 TUNING UNITS. If replacement of the signal calibrator reflex klystron of these Tuning Units is necessary, proceed as outlined in paragraph 4-69, substituting "signal calibrator" in place of "first local oscillator" and "S.C. Opr Bias control R613 or R713" in place of "L.O. Opr Bias control R614 or R714."

4-88. SIGNAL CALIBRATOR, REFLECTOR VOLTAGE TRACKING.

4-89. Due to variations in reflex klystron characteristics, the replacement of the signal calibrator will necessitate retracking of the reflex klystron signal calibrator reflector voltage. The procedure for tracking the reflector voltage of the Models FIM-L2 and FIM-X2 Tuning Unit signal calibrators, which employ mode switching, is outlined in paragraph 4-90; that for the Models FIM-S2 and FIM-M2 Tuning Unit signal calibrators, which do not employ mode switching, is outlined in paragraph 4-91.

4-90. MODELS FIM-L2 AND FIM-X2 TUNING UNITS. To retrack the signal calibrator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-L2 Tuning Unit, and immediately follows the information applying to the Model FIM-X2 Tuning Unit.

a. Connect r-f cable assembly W1202 between the SIG GEN OUT jack and the input connector of a frequency meter, as shown in figure 4-33.

b. Connect a crystal detector, having a d-c return, to the output connector of the frequency meter, as shown in figure 4-33.

c. Connect the vertical input terminals of a high-gain oscilloscope across the output of the crystal detector, as shown in figure 4-33.

NOTES:

1. FXR Model N410A Frequency Meter used with Model FIM-L2 Tuning Unit.
FXR Model N410A and H410A Frequency Meters used with Model FIM-S2 Tuning Unit.
FXR Model H410A and C410A Frequency Meters used with Model FIM-M2 Tuning Unit.
FXR Model W410A Frequency Meter used with Model FIM-X2 Tuning Unit.
2. PRD Model 357 Waveguide-to-Coax Adapter used with FXR Model H410A Frequency Meter.
PRD Model 356A Waveguide-to-Coax Adapter used with FXR Model C410A Frequency Meter.
PRD Model 354B Waveguide-to-Coax Adapter used with FXR Model W410A Frequency Meter.

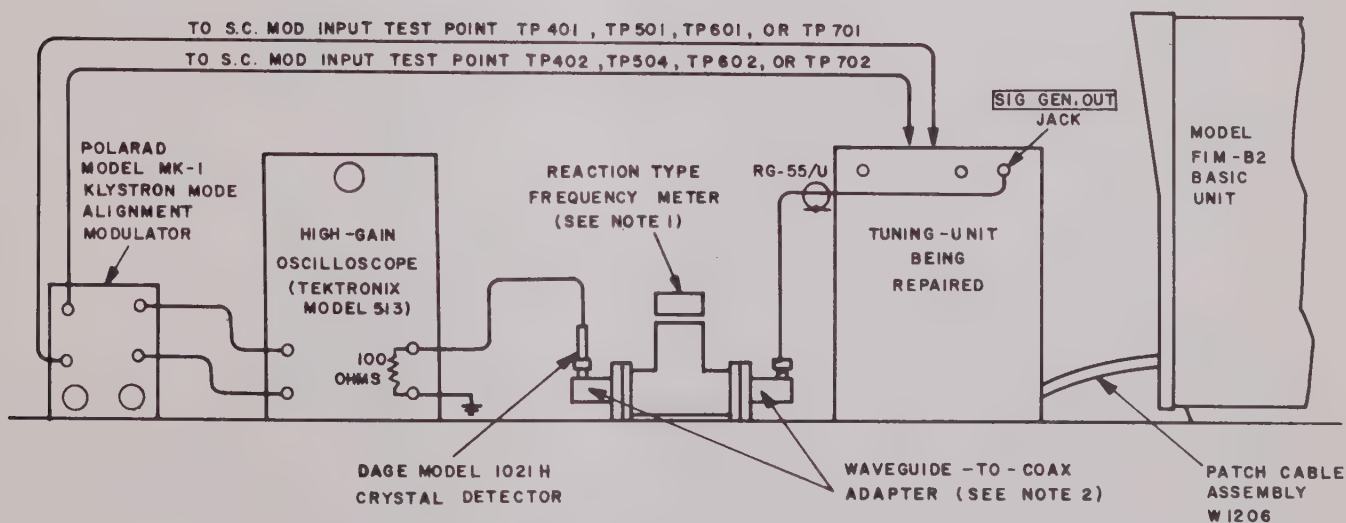


Figure 4-33. Tracking Signal Calibrator Reflecter Voltage, Equipment Set Up.

d. Connect the "reflector" terminals of a Polarad Model MK-1 Klystron Mode Alignment Modulator (see figure 4-27) to the Tuning Unit S.C. Mod Input test points, TP/01 and TP/02 (TP401 and TP402), as shown in figure 4-33.

e. Connect the horizontal input terminals of the high-gain oscilloscope to the "h scope" and "ground" terminals of the MK-1, as shown in figure 4-33.

f. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-33.

g. Apply operating power to the FIM-2.

h. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light, indicating that the high-voltage power supply is energized. Allow the FIM-2 to stabilize for at least 15 minutes.

i. Set Test Selector switch S351 (located on the meter adjust board) to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region of the power monitor meter scale will necessitate retracking of the first local oscillator reflector voltage. Refer to paragraph 4-72.

j. Adjust Refl Adjust control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the power monitor meter scale.

k. Set the FUNCTION SEL switch to CAL SIG GEN.

l. Set the Test Selector switch to Anode Ma.

NOTE:

Be sure to first adjust the bias of the first local oscillator to obtain the proper "Anode Ma" set indication, as outlined in paragraph 4-73 (paragraph 4-72).

m. Adjust S.C. Opr Bias control R713 (R413) to obtain a power monitor meter pointer deflection shown in figure 4-35 (figure 4-35).

n. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam.

NOTE:

In the Model FIM-L2 Tuning Unit, the signal calibrator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGACYCLES dial drum. In the Model FIM-X2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers.

o. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to 0.

p. Rotate the SIGNAL CALIBRATOR FINE TUNING control to 0.

q. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope screen. If the mode pattern is not centered, as shown in figure 3-31a, or does not appear on the oscilloscope screen, proceed as outlined in the following steps.

1. Rotate the TUNING control to a point just above the mode switching point.

2. Center the mode pattern on the oscilloscope screen, as shown in figure 4-31b, by adjusting S.C. High Mode control R733 (R433).

3. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a convenient amplitude on the oscilloscope screen.

4. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.

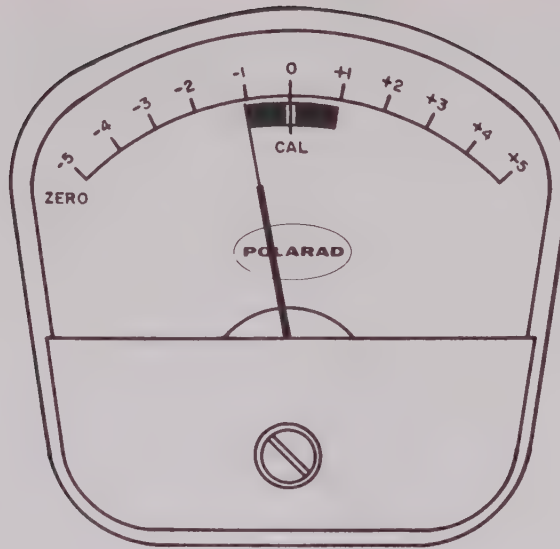


Figure 4-34. Power Monitor Meter Pointer Deflection
Corresponding to "Anode Ma" Set, Models FIM-X2
and FIM-M2 Tuning Units (FUNCTION SEL
Switch Set to CAL SIG GEN)

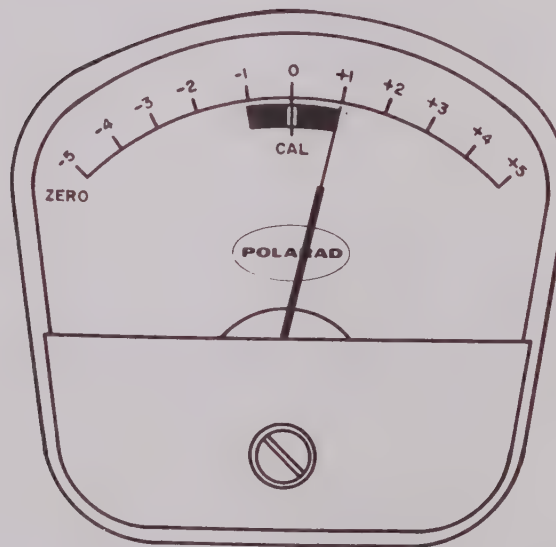


Figure 4-35. Power Monitor Meter Pointer Deflection
Corresponding to "Anode Ma" Set, Models FIM-L2
and FIM-S2 Tuning Units (FUNCTION SEL
Switch Set to CAL SIG GEN)

5. Connect the positive probe of a d-c vtvm to pin 3 of TB701 (TB401). Connect the common probe to S.C. Mod Input test point TP701 (TP401).

6. Note the vtvm reading. A reading within the limits of 125 and 210 volts (45 and 95 volts) indicates that the signal calibrator is operating in the desired 4-3/4-wave (2-3/4-wave) reflector mode.

7. Rotate the TUNING control to a point just below the mode switching point.

8. Center the mode pattern on the oscilloscope screen by adjusting S.C. Low Mode control R746 (R446).

9. Note the vtvm reading. A reading within the limits of 290 and 375 volts (125 and 175 volts) indicates that the signal calibrator is operating in the desired 3-3/4-wave (1-3/4-wave) reflector mode.

10. Rotate the TUNING control to the high end of the band.

11. Center the mode pattern on the oscilloscope screen by adjusting S.C. High control R731 (R431).

12. Note the vtvm reading. A reading within the limits of 350 and 450 volts (210 and 260 volts) indicates that the signal calibrator is operating in the desired 4-3/4-wave (2-3/4-wave) reflector mode.

13. Rotate the TUNING control to the low end of the band.

14. Center the mode pattern on the oscilloscope screen by adjusting S.C. Low control R775 (R475).

15. Note the vtvm reading. A reading within the limits of 150 and 225 volts (65 and 115 volts) indicates that the signal calibrator is operating in the desired 3-3/4-wave (1-3/4-wave) reflector mode.

r. Remove the vtvm.

s. Rotate the TUNING control from one end of the band to the other. The mode pattern displayed on the oscilloscope screen should be continuous and display no splitting or loss of power at any point, and remain centered on the oscilloscope screen.

NOTE:

If the mode pattern is erratic at any point within the band, rotate the TUNING control to the point of discontinuity and remove operating power from the FIM-2. Loosen the single clamp screw which secures the protective shield to the knurled end collar and remove the shield. Remove the klystron socket, loosen the end collar, and gently rotate the base of the reflex klystron clockwise. Tighten the end collar, replace the socket and shield, and reenergize the FIM-2. Rescan the band for continuity as in step s, above.

Since the orientation of the reflex klystron tube within the cavity for optimum performance cannot be anticipated, it is suggested that the tube rotating procedure be performed in 30-degree increments until continuity throughout the band is achieved.

t. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

u. Tune the frequency meter to that frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

v. Adjust the signal calibrator cavity coarse frequency adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode pattern, as shown in figure 4-3ld.

w. Rotate the TUNING control to position the cam follower opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-30.)

x. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note the FREQUENCY IN KILOMEGACYCLES dial indication and the frequency meter indication. They should be separated by no more than 1%.

y. Repeat steps w and x, above for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter indication should be separated by no more than 1% from the FREQUENCY IN KILOMEGACYCLES dial indication. If the frequency difference is outside the limit of 1%, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE FIRST BEEN LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB TO THE ADJUSTABLE PERIPHERY OF THE TUNING CAM.

1. If the error occurs at the high end of the band, loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3; if the error occurs at the low end of the band, loosen, in the order stated, eccentric adjustment bolts no. 4 and 5.

2. With the cam follower resting at the fixed point of the adjustable periphery tuning cam, rotate the TUNING control, either toward the high end of the band or the low end of the band, as required, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.

3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to this frequency.

4. Adjust the position of the adjustable periphery tuning cam tab until the dip appears at the peak of the displayed mode.

5. Tighten the eccentric adjustment bolt.

6. Repeat steps 2 through 6, above, for the remainder of the eccentric adjustment bolts.

z. Remove the leads from the S.C. Mod Input test points.

aa. Disconnect r-f cable assembly W1202 from the SIG GEN OUT jack.

4-91. MODELS FIM-S2 AND FIM-M2 TUNING UNITS. To retrack the signal calibrator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-S2 Tuning Unit, and immediately follows the information applying to the Model FIM-M2 Tuning Unit.

a. Connect r-f cable assembly W1202 between the SIG GEN OUT jack and the input connector of a frequency meter, as shown in figure 4-33.

b. Connect a crystal detector, having a d-c return, to the output connector of the frequency meter, as shown in figure 4-33.

c. Connect the vertical input terminals of a high-gain oscilloscope across the output of the crystal detector, as shown in figure 4-33.

d. Connect the "reflector" terminals of the Model MK-1 Klystron Mode Alignment Modulator (see figure 4-27) to the Tuning

Unit S.C. Mod Input test points, TP601 and TP602 (TP501 and TP502), as shown in figure 4-33.

e. Connect the horizontal input terminals of the high-gain oscilloscope to the "h scope" and "ground" terminals of the Model MK-1, as shown in figure 4-33.

f. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-33.

g. Apply operating power to the FIM-2.

h. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light. Allow the FIM-2 to stabilize for 15 minutes.

i. Set Test Selector switch S351 to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region of the scale will necessitate retracking of the first local oscillator reflector voltage. Refer to paragraph 4-73.

j. Adjust Refl Adjust control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the scale.

k. Set the FUNCTION SEL switch to CAL SIG GEN.

l. Set Test Selector switch S351 to Anode Ma.

NOTE:

Be sure to first adjust the bias of the first local oscillator to obtain the proper "Anode Ma" set indication, as outlined in paragraph 4-73 (paragraph 4-72).

m. Rotate S.C. Opr Bias control R613 (R513) to obtain a power monitor meter pointer deflection corresponding to figure 4-34 figure 4-35).

n. Rotate the TUNING control to position the cam follower opposite the fixed point of the adjustable periphery tuning cam.

NOTE:

In the Model FIM-S2 Tuning Unit, the signal calibrator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGACYCLES dial drum. In the Model FIM-M2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers.

- o. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to 0.
- p. Rotate the SIGNAL CALIBRATOR FINE TUNING control to 0.
- r. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope screen. If the mode pattern is not centered, as shown in figure 4-31a, or does not appear on the oscilloscope screen, proceed as outlined in the following additional steps.
 - 1. Rotate the TUNING control to the high end of the band.
 - 2. Center the mode pattern on the oscilloscope screen, as shown in figure 4-31b, by adjusting S.C. High control R631 (R531).
 - 3. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a display of convenient amplitude on the oscilloscope screen.
 - 4. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.
 - 5. Connect the positive probe of a d-c vtvm to pin 3 of TB601 (TB501). Connect the common probe to S.C. Mod Input test point TP601 (TP501).
 - 6. Note the vtvm reading. A reading within the limits of 425 and 600 volts (230 and 330 volts) indicates that the signal calibrator is operating in the desired 2-3/4-wave (2-3/4-wave) reflector mode.

7. Rotate the TUNING control to the low end of the band.

8. Center the mode pattern on the oscilloscope screen by adjusting S.C. Low control R675 (R575).

9. Note the vtvm reading. A reading within the limits of 75 and 150 volts (20 and 60 volts) indicates that the signal calibrator is operating in the desired 2-3/4-wave (2-3/4-wave) reflector mode.

NOTE:

Due to some interaction between the above controls, it may be necessary to repeat the above steps for optimum setting of the controls throughout the Tuning Unit frequency range.

s. Remove the vtvm.

t. Rotate the TUNING control from one end of the band to the other. The mode pattern displayed on the oscilloscope screen should be continuous and exhibit no splitting or loss of power at any point, and remain centered on the oscilloscope screen.

NOTE:

If the displayed mode pattern is erratic at any point within the band, rotate the TUNING control to the discontinuity and remove operating power from the FIM-2. Loosen the single clamp screw that secures the protective shield to the end collar and remove the shield. Remove the klystron socket, loosen the end collar, and gently rotate the klystron tube clockwise. Replace the socket and shield and reenergize the FIM-2. Rescan the band for continuity as in step t, above.

Since the orientation of the reflex klystron tube within the external resonant cavity for optimum performance cannot be anticipated, it is suggested that the tube rotating procedure be performed in 30-degree increments until continuity throughout the band is achieved.

u. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

v. Tune the frequency meter to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

w. Adjust the signal calibrator cavity coarse tuning adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode, as shown in figure 4-31d.

x. Rotate the TUNING control to that the cam follower rests opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-27.)

y. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note the FREQUENCY IN KILOMEGACYCLES dial indication and the frequency meter indication. They should be separated by no more than 1%.

z. Repeat steps x and y, above for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter indication and FREQUENCY IN KILOMEGACYCLES dial indications should be separated by no more than 1%. If the frequency difference is greater than 1%, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE BEEN FIRST LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB TO THE ADJUSTABLE PERIPHERY OF THE CAM.

1. If the error occurs at the high end of the band, loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3; if the error occurs at the low end of the band, loosen, in the

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order stated, eccentric adjustment bolts no. 4 and 5.

2. With the cam follower resting at the fixed point of the adjustable periphery tuning cam, rotate the TUNING control either toward the high end of the band or the low end of the band, as required, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.

3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to this frequency.

4. Adjust the position of the adjustable periphery tuning cam tab until the dip appears at the peak of the displayed mode.

5. Tighten the eccentric adjustment bolt.

6. Repeat steps 2 through 5, above for the remainder of the eccentric adjustment bolts.

aa. Remove the leads from the S.C. Mod Input test points.

ab. Disconnect r-f cable assembly W1202 from the SIG GEN OUT jack.

4-92. PRESELECTOR, ALIGNMENT.

4-93. Replacement of the first local oscillator reflex klystron will necessitate realignment of the Tuning Unit preselector. In the Models FIM-L2 and FIM-S2 Tuning Units, the preselectors are aligned by a series of adjusting screws located at the top of the preselector subassembly. In the Models FIM-M2 and FIM-X2 Tuning Units, they are aligned by an L-shaped rocker arm that is actuated by a cam follower driven by the profile of a tape cam. The profile of this tape cam is controlled by a series of adjusting screws located on a rack positioned above the preselector subassembly. If alignment of the Model FIM-L2 or FIM-S2 Tuning Unit preselector is required, proceed as outlined in paragraph 4-94. If alignment of the Model FIM-M2 or FIM-X2 Tuning Unit preselector is required, proceed as outlined in paragraph 4-95.

4-94. MODELS FIM-L2 AND FIM-S2 TUNING UNITS. To align the preselectors of these Tuning Units, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-L2 Tuning Unit, and immediately follows the information applying to the Model FIM-S2 Tuning Unit.

a. Set the POWER switch to OFF.

b. Loosen and remove the four screws that secure the preselector end plate to the preselector subassembly. Remove the end plate, placing the screws and their associated hardware in an accessible location.

c. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.

d. Adjust the preselector fine tuning adjustment screws so that they are flush with the outer surface (inner surface) of the preselector subassembly (preselector cavity).

e. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-36.

f. Apply operating power to the FIM-2.

g. Set the POWER switch to ON. Allow the FIM-2 to stabilize for at least 15 minutes.

h. Connect a length of RG-55/U coaxial cable between the MIXER OUT jack and the IF IN jack, as shown in figure 4-36.

i. Rotate the IF GAIN control to a front-panel indication of 6.

j. Remove all i-f attenuation from the system.

k. Set the FUNCTION SEL switch to OPERATE.

l. Set the OUTPUT switch to ZERO SET.

m. Adjust the output meter ZERO SET control to zero-set the output meter.

n. Rotate the TUNING control to obtain a FREQUENCY IN KILOMEGACYCLES dial indication of 4.34 kmc (2.24 kmc).

o. Adjust a calibrated microwave signal generator, such as a Polarad Model MSG-2A Microwave Signal Generator (Polarad Model MSG-1 Microwave Signal Generator), for minimum output at the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

p. Connect the microwave signal generator to the PRESEL IN jack, as shown in figure 4-36.

NOTE:

Polarad Model MSG-1 Microwave Signal Generator used with Model FIM-L2 Tuning Unit.
 Polarad Model MSG-2A Microwave Signal Generator used with Model FIM-S2 Tuning Unit.
 Polarad Model PMX Microwave Signal Generator (with G-48 Tuning Unit) used with Model FIM-M2 Tuning Unit.
 Polarad Model PMX Microwave Signal Generator (with G-711' Tuning Unit) used with Model FIM-X2 Tuning Unit.

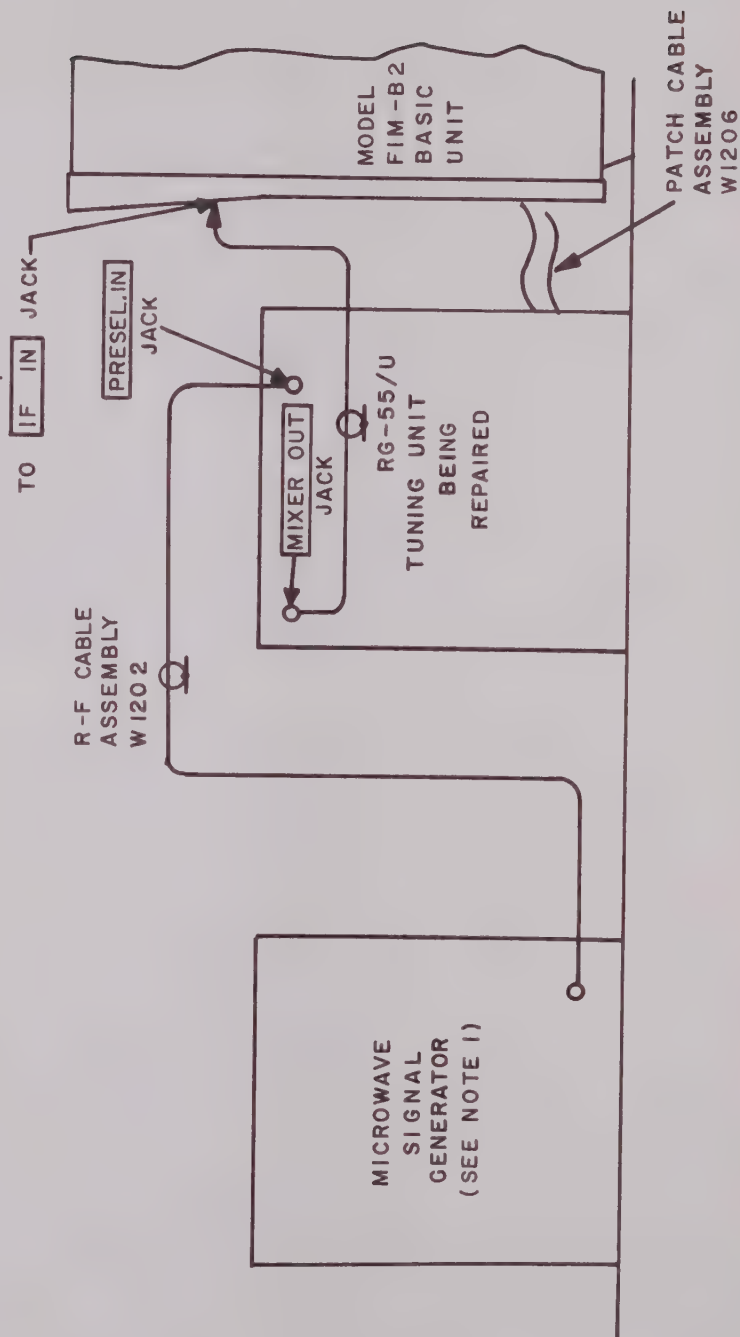


Figure 4-36. Presetor Alignment, Equipment Set Up

- q. Set the OUTPUT switch to AVERAGE.
- r. Adjust the output level of the microwave signal generator to 1,000 microvolts.
- s. Note the output meter pointer deflection.
- t. Adjust the preselector cavity coarse frequency adjust screws, shown in figure 4-25, sheet 3, to peak the deflection of the output meter pointer.
- u. With the aid of a vernier caliper, determine the distance S from the end of the preselector subassembly to the center of the nearest preselector fine tuning adjustment screw, as shown in figure 4-37.
- v. Insert the vernier caliper into the preselector cavity and adjust the TUNING control to position the preselector tuning plunger beneath the center of the nearest preselector fine tuning adjustment screw. This corresponds to the distance D in figure 4-37.
- w. Note the FREQUENCY IN KILOMEGACYCLES dial indication.
- x. Tune the calibrated microwave signal generator to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.
- y. Adjust the output level of the calibrated signal generator to 1,000 microvolts.
- z. Adjust the set of preselector fine tuning adjustment screws to peak the deflection of the output meter pointer.
- aa. Repeat steps u through z, above, for the remaining sets of preselector fine tuning adjustment screws.
- ab. After all the preselector fine tuning adjustment screws have been aligned, disconnect the calibrated microwave signal generator from the PRESEL IN jack and determine the sensitivity of the FIM-2 at various frequencies within the band. (Refer to paragraph 2-36.) The minimum sensitivity should be at least -81 dbm. If the

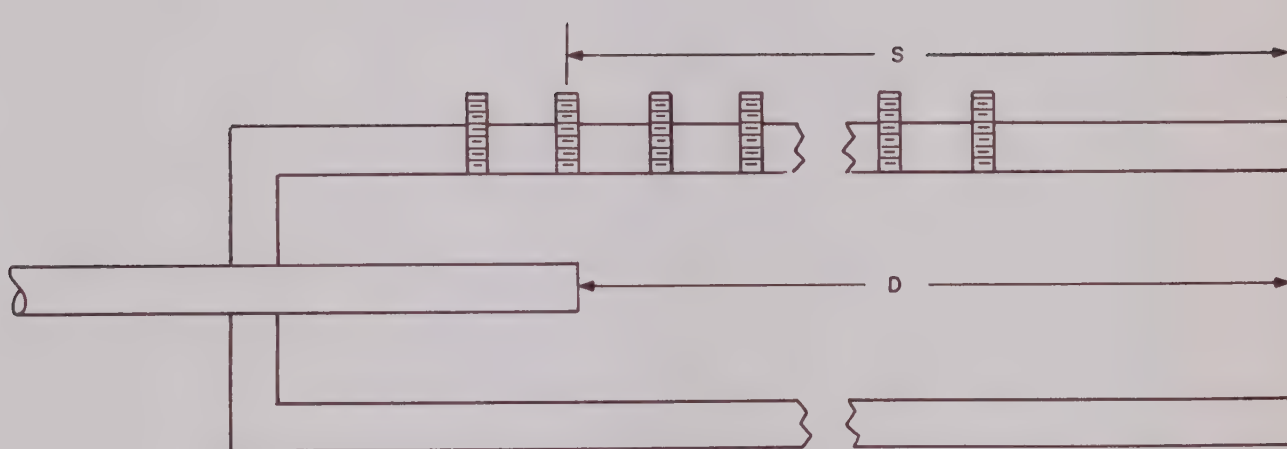


Figure 4-37. Models FIM-L2 and FIM-S2 Tuning Unit
Preselector, Sectional Side View

sensitivity is low, readjustment of the preselector fine tuning adjustment screws will be necessary.

4-95. MODELS FIM-M2 AND FIM-X2 TUNING UNITS. To align the preselectors of these Tuning Units, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-M2 Tuning Unit, and immediately follows the information applying to the Model FIM-X2 Tuning Unit.

- a. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.
- b. Set the POWER switch to OFF.
- c. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-36.
- d. Apply operating power to the FIM-2.
- e. Set the POWER switch to ON. Allow the FIM-2 to stabilize for at least 15 minutes.
- f. Connect a length of RG-55/U coaxial cable between the MIXER OUT jack and the IF IN jack, as shown in figure 4-36.
- g. Rotate the IF GAIN control to a front-panel indication of 6.
- h. Remove all i-f attenuation from the system.
- i. Set the FUNCTION SEL switch to OPERATE.
- j. Set the OUTPUT switch to ZERO SET.
- k. Adjust the output meter ZERO SET control to zero-set the output meter.
- l. Rotate the TUNING control to obtain a FREQUENCY IN KILOMEGACYCLES dial indication of 10.00 kmc (7.74 kmc).

m. Adjust a calibrated microwave signal generator, such as the Polarad Model PMX Microwave Signal Generator, for minimum output at the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

n. Connect the microwave signal generator to the PRESEL IN jack, as shown in figure 4-36.

o. Set the OUTPUT switch to AVERAGE.

p. Adjust the output level of the calibrated microwave signal generator to 1,000 microvolts.

q. Note the output meter pointer deflection.

r. Adjust the preselector cavity coarse frequency adjust screws, shown in figure 4-25, sheet 3, to peak the deflection of the output meter pointer.

s. Place a small mirror, such as a dental mirror, beside the tape cam so that the cam may be easily viewed.

t. Adjust the TUNING control so that the L-shaped rocker arm rollers lie directly below the nearest set of preselector fine tuning adjustment screws.

u. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

v. Tune the calibrated microwave signal generator to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

w. Adjust the output level of the calibrated microwave signal generator to 1,000 microvolts.

x. Adjust the set of preselector fine tuning adjustment screws to peak the deflection of the output meter pointer.

y. Repeat steps t through x, above, for the remaining sets of preselector fine tuning adjustment screws.

z. After all the preselector fine tuning adjustment screws have been aligned, disconnect the calibrated microwave signal gener-

ator from the PRESEL IN jack and determine the sensitivity of the FIM-2 at various frequencies within the band. (Refer to paragraph 2-36.) The minimum sensitivity should be at least -81 dbm. If the sensitivity is low, readjustment of the preselector fine tuning adjustment screws will be necessary.

4-96. LOW-PASS FILTERS, TROUBLESHOOTING.

4-97. Low-pass filters are employed in the low-frequency Tuning Units; one each between the PRESEL IN jack and the input to the preselector subassembly in the Models FIM-L2 and FIM-S2 Tuning Units, the third between the output of the first crystal mixer and the MIXER OUT jack of the Model FIM-L2 Tuning Unit. To troubleshoot these low-pass filters, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis refers to the filters between the MIXER OUT jack and the output of the first crystal mixer in the Model FIM-L2 Tuning Unit.

a. Connect a calibrated microwave signal generator, tuned to any frequency within the band, to the output connector of the filter. (Connect a calibrated signal generator, tuned to 260 mc, to the input connector of the filter.)

b. Adjust the output level of the calibrated microwave signal generator to 0 dbm. (Adjust the output level of the calibrated signal generator to 100,000 microvolts.)

c. Connect a microwave power meter, such as the Polarad Model P-3 Power Meter, to the PRESEL IN jack through a thermistor mount, such as the Polarad Model TM-1 Thermistor Mount. (Connect an a-c vtvm between the center and outer conductors of the MIXER OUT jack.)

d. Note the reading of the microwave power meter. It should indicate no less than -2 dbm. (Note the reading of the a-c vtvm. It should indicate no less than 0.795 volts.) In other words, the maximum insertion loss of the low-pass filter should be no greater than 2 db.

4-98. LOW-PASS FILTERS, REMOVAL.

4-99. To remove the low-pass filters from the Tuning Unit, proceed as outlined in the following steps.

a. Disconnect the r-f cable assembly, which couples the output of the low-pass filter to the input connector of the pre-selector, from the output connector of the filter. (Disconnect the i-f cable assembly, which couples the output of the low-pass filter to the MIXER OUT jack, from the output connector of the filter.)

NOTE:

When removing the low-pass filter between the MIXER OUT jack and the output of the first crystal mixer of the Model FIM-L2 Tuning Unit, remove the i-f cable assembly which couples the coaxial "tee" to the input connector of the low-pass filter.

b. Loosen and remove the four screws which secure the filter to the PRESEL IN mounting hole. (Loosen and remove the clamps which secure the filter to the Tuning Unit frame.)

c. Remove the filter.

4-100. LOW-PASS FILTER, REPLACEMENT.

4-101. To install the replacement low-pass filter, follow both the reverse procedure and sequence of paragraph 4-98, steps a through c.

4-102. SIGNAL CALIBRATOR OUTPUT ATTENUATOR PROBE, REMOVAL.

4-103. To remove the signal calibrator output attenuator probe from the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.

b. Loosen and remove the four screws that secure the SIG GEN OUT jack to the Tuning Unit front panel. Place the screws and their associated hardware in an accessible location.

c. Remove the SIG GEN OUT jack from its mounting hole.

d. Loosen the two setscrews (7 , figure 4-32) that secure the signal calibrator output attenuator probe (8 , figure 4-32) to the signal calibrator output attenuator probe yoke (9 , figure 4-32).

e. Grasp the coaxial cable connecting the signal calibrator output attenuator probe and the SIG GEN OUT jack and carefully remove the signal calibrator output attenuator probe from both the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe (10, figure 4-32) and the signal calibrator output attenuator probe yoke (7, figure 4-32).

f. Grasp the signal calibrator output attenuator probe yoke and carefully remove it from its slotted mounting location in the signal calibrator output attenuator drive yoke (11, figure 4-32).

g. Place the signal calibrator output attenuator probe yoke in an accessible location.

4-104. SIGNAL CALIBRATOR OUTPUT ATTENUATOR PROBE, REPLACEMENT.

4-105. To insert the replacement signal calibrator output attenuator probe into the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Insert the signal calibrator output attenuator probe yoke (9, figure 4-32) into its slotted mounting in the signal calibrator output attenuator drive yoke (11, figure 4-32). Be sure to orient the former so that its setscrews are located above the uppermost surface of the latter.

b. Insert the signal calibrator output attenuator probe (8, figure 4-32) through the signal calibrator output attenuator probe yoke and into the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe (10, figure 4-32).

c. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully clockwise.

d. Adjust the position of the signal calibrator output attenuator probe so that:

1. the end of the signal calibrator output attenuator probe barrel is flush with the top surface of the signal calibrator output attenuator probe yoke, and

2. the line engraved on the signal calibrator output attenuator probe barrel lines up with the line engraved on the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe.

e. Tighten the two setscrews (7, figure 4-32), thereby securing the signal calibrator output attenuator probe to the signal calibrator output attenuator probe yoke.

f. Insert the SIG GEN OUT jack into its front panel mounting hole and replace the four mounting screws.

g. Tighten the four screws, thereby securing the SIG GEN OUT jack to the Tuning Unit front panel.

h. Proceed to paragraph 4-106 to calibrate the output power of the signal calibrator.

4-106. SIGNAL CALIBRATOR POWER OUTPUT CALIBRATION.

4-107. To calibrate the output power of the signal calibrator after the replacement of the signal calibrator output attenuator probe, the signal calibrator thermistor probe, or the signal calibrator thermistor mount, proceed as outlined in the following steps.

a. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit.

b. Apply operating power to the FIM-2.

c. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light, indicating that the high-voltage power supply is energized. Allow the FIM-2 to stabilize for at least 15 minutes.

d. Set the FUNCTION SEL switch to ZERO SET.

e. Rotate the power monitor meter ZERO SET control fully clockwise.

f. Adjust the Bridge Coarse Int Adj control (R409, R509, R609, or R709, depending on the Tuning Unit) to obtain a power monitor meter pointer deflection of +5 (full scale).

g. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

h. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.

i. Set the FUNCTION SEL switch to CAL SIG GEN.

j. Connect a microwave power meter, such as the Polarad Model P-3 Microwave Power Meter, to the SIG GEN OUT jack through a thermistor mount, such as the Polarad Model TM-1 Thermistor Mount, as shown in figure 4-38.

k. Rotate the TUNING control to the low end of the band.

l. Rotate the SIGNAL CALIBRATOR POWER SET control fully clockwise.

m. Loosen the two setscrews (1, figure 4-32) that secure the signal calibrator thermistor probe (2, figure 4-32) to the signal calibrator thermistor probe drive yoke (3, figure 4-32).

CAUTION:

CARE SHOULD BE EXERCISED SO AS NOT TO DAMAGE THE "HATS" THAT ARE LOCATED WITHIN THE SIGNAL CALIBRATOR EXTERNAL CAVITIES OF THE MODELS FIM-L2 AND FIM-M2 TUNING UNITS. SHOULD THESE "HATS" BE BENT OR DAMAGED IN ANY WAY, THE FREQUENCY ALIGNMENT OF THE SIGNAL CALIBRATOR WILL BE VOID.

n. Carefully adjust the degree of insertion of the signal calibrator thermistor probe within the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32) so that the power monitor meter pointer deflects to an indication of between +3 and +5.

o. Tighten the two setscrews (1, figure 4-32), thereby securing the signal calibrator thermistor probe to the signal calibrator thermistor probe drive yoke.

p. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL.

q. Rotate the TUNING control throughout the band. At various frequencies adjust the SIGNAL CALIBRATOR POWER SET control to ascertain that power monitor meter pointer deflections both above and below the CAL mark can be obtained.

r. Rotate the TUNING control to the low end of the band.

s. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL.

t. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial (12, figure 4-32) under the hairline of the power set indicator (13, figure 4-32).

u. Note the reading of the microwave power meter (in dbm).

v. Rotate the TUNING control throughout the band, stopping at increments of 100 mc. At each point readjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL, and then adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial beneath the hairline of the power set indicator. Note the microwave power meter reading at each point (in dbm). The difference between the maximum and minimum microwave power meter readings should be 4 db or less.

w. Substitute the values obtained for the maximum and minimum signal calibrator output power into the following formula to obtain the average overall db error

$$\text{Average overall db error} = \frac{P_{\text{max}}(\text{dbm}) - P_{\text{min}}(\text{dbm})}{2}$$

x. Rotate the TUNING control to the low-power frequency and adjust the LOCK lever to prevent the TUNING control from moving.

y. Loosen the two setscrews that secure the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control knob to its shaft.

z. Remove the knob from its shaft.

aa. Loosen the two setscrews that secure the SIGNAL CALIBRATOR POWER SET control knob to its shaft.

ab. Remove the knob from its shaft.

ac. Remove the two pilot lights from their housing in the attenuator dial cover.

ad. Loosen and remove the single screw, located between the two control shafts protruding from the attenuator dial cover, thereby removing the attenuator dial cover from its mounting on the Tuning Unit front panel.

ae. Remove the attenuator dial cover.

af. Set the FUNCTION SEL switch to ZERO SET.

ag. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

ah. Set the FUNCTION SEL switch to CAL SIG GEN.

ai. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL.

aj. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a microwave power meter reading corresponding to the low-power value determined in step v, above.

ak. Loosen the two setscrews which secure the -DBM MICROVOLTS dial to its shaft.

al. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control so that the -DBM MICROVOLTS dial 0 dbm mark lies beneath the power set indicator hairline.

am. Tighten the two setscrews to secure the -DBM MICROVOLTS dial to its shaft.

an. Recheck those frequencies covered in step v, above, for power output. At each frequency first zero-set the power monitor meter and then adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL. Then adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial beneath the power set indicator hairline. Note the microwave power meter reading. It should read 0 dbm $\pm$ 2 db. To improve the accuracy of the signal calibrator output level, prepare calibration charts as outlined in the following additional steps.

1. At 100 mc increments, zero-set the power monitor meter and adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a microwave power meter indication of 0 dbm.

2. Adjust the SIGNAL CALIBRATOR POWER SET control to position the power set indicator directly above the 0 dbm mark of the -DBM MICROVOLTS dial.

3. Note the power monitor meter pointer deflection. Transfer this reading to a chart on which frequency is plotted along the abscissa and power monitor meter deflection is plotted along the ordinate. When using the signal calibrator, adjust the SIGNAL CALIBRATOR POWER SET control to the indication on the chart. This corresponds to a power monitor meter pointer deflection of "cal."

ao. To reset the SIGNAL CALIBRATOR OUTPUT ATTENUATOR stops, proceed as outlined in the following additional steps.

1. Rotate the TUNING control to the low end of the band.

2. Rotate the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection corresponding to "cal."

3. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the power set indicator hairline a distance corresponding to 1 db on the positive side of the -DBM MICROVOLTS 0 dbm mark. If this cannot be obtained, loosen the two setscrews on the SIGNAL CALIBRATOR OUTPUT ATTENUATOR stop yoke. Grasp the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control drive shaft with one hand and rotate it clockwise till the +1 dbm mark lies directly beneath the power set indicator hairline. With the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control drive shaft still grasped, rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR stop clockwise until it meets a positive stop. Then tighten the two SIGNAL CALIBRATOR OUTPUT ATTENUATOR stop setscrews.

ap. Replace the attenuator dial cover.

aq. Screw the attenuator dial cover to the Tuning Unit front panel.

ar. Replace the SIGNAL CALIBRATOR POWER SET knob on its shaft.

as. Tighten the two setscrews to secure the SIGNAL CALIBRATOR POWER SET knob to its shaft.

at. Replace the SIGNAL CALIBRATOR OUTPUT ATTENUATOR knob on its shaft.

au. Tighten the two setscrews to secure the SIGNAL CALIBRATOR OUTPUT ATTENUATOR knob on its shaft.

av. Replace the two pilot lights.

4-108. INPUT ATTENUATOR ASSEMBLY, TROUBLESHOOTING.

4-109. To troubleshoot the r-f input attenuator assembly, proceed as outlined in the following steps.

a. Disconnect the r-f cables associated with the input attenuator assembly and check them for continuity. Replace any defective cable.

b. Check the attenuation of each of the r-f attenuators. They should each have a nominal attenuation of 20 db. Replace any defective attenuator.

c. Check the operation of the coaxial r-f input attenuator switches. Replace if necessary.

d. Check the operation of coaxial r-f transfer switch S1101. Replace if necessary.

4-110. INPUT ATTENUATOR ASSEMBLY, CALIBRATION.

4-111. Replacement of any one of the five calibrated coaxial r-f input attenuators will require recalibration of that particular section of the input attenuator assembly containing the replacement attenuator. To recalibrate the input attenuator assembly, proceed as outlined in paragraph 2-22, steps a through v. Then proceed as outlined in the following additional steps.

a. Disconnect P326 from J326 of the 140-mc i-f attenuator subassembly.

b. Disconnect P325 from J325 of the 140-mc i-f attenuator subassembly.

c. Connect a standard calibrated i-f attenuator, using a 6-db 50-ohm pad at each end, between P326 and P325, as shown in figure 4-38.

d. Adjust the standard calibrated i-f attenuator so that

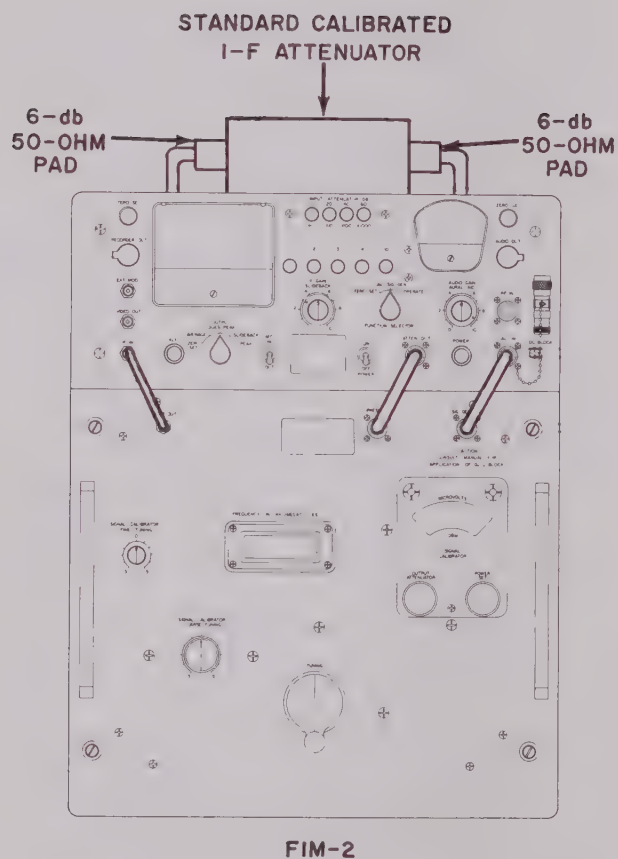


Figure 4-38. Calibrating Input Attenuator
Assembly, Equipment Set Up

no i-f attenuation is inserted.

e. Depress the r-f INPUT ATTENUATOR DB push-button switch corresponding to that section of the input attenuator assembly repaired.

f. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a reference deflection on the output meter scale. Note this deflection.

g. Note the -DBM MICROVOLTS dial indication on the -dbm scale.

h. Insert 20-db of calibrated i-f attenuation.

i. Depress the next lower r-f INPUT ATTENUATOR DB push-button switch.

j. Note the output meter pointer deflection.

k. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain the same output meter pointer deflection as in step f.

l. Through the use of the attenuator correction curves supplied with the Basic Unit, determine the db error of the replacement attenuator. Repeat the above steps for other frequency values throughout the band.

4-112. ALIGNING EXTERNAL MODULATION CIRCUIT.

4-113. To align the external modulation circuit of Basic Unit serial nos. 291, 294, 297, 298, 307 to 312, 3-15, 3-16, 321, and 3-22, proceed as outlined in paragraph 2-21, steps a through v. Then proceed as outlined in the following additional steps.

a. Disconnect r-f cable assembly W1205 from between the SIG GEN OUT jack and the CAL IN jack.

b. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output level of 0 dbm, as indicated on the -DBM MICROVOLTS dial.

c. Connect a d-c oscilloscope, through a crystal detector, to the SIG GEN OUT jack.

d. Note the trace on the oscilloscope screen.

e. Set the FUNCTION SEL switch to ZERO SET.

f. Note the trace on the oscilloscope screen. The d-c level should differ from that of step d.

g. Adjust the oscilloscope vertical sensitivity to obtain a difference of three boxes between the levels of steps d and f.

h. Connect the positive probe of a d-c voltmeter between pin 19 of TB300 and ground.

i. Adjust Clipping Level Adj. control R389 to obtain a voltmeter indication of +40 volts.

j. Connect a pulse generator, adjusted for a positive pulse train output of 50 volts peak at 100 pps and a width of from 5 to 9 microseconds, to the EXT MOD jack.

k. Observe the oscilloscope display. The pulses should have a relatively flat bottom. Check for pulsing throughout the band. Repeat steps a through k for all other Tuning Units available. If any Tuning Unit cannot be pulsed, continue to step l.

l. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise and set the SIGNAL CALIBRATOR COARSE TUNING and SIGNAL CALIBRATOR FINE TUNING controls to 0.

m. If unable to pulse Tuning Unit, check signal calibrator reflector modes. If bad tilt appears on oscilloscope screen, increase the voltage at pin 19 of TB300.

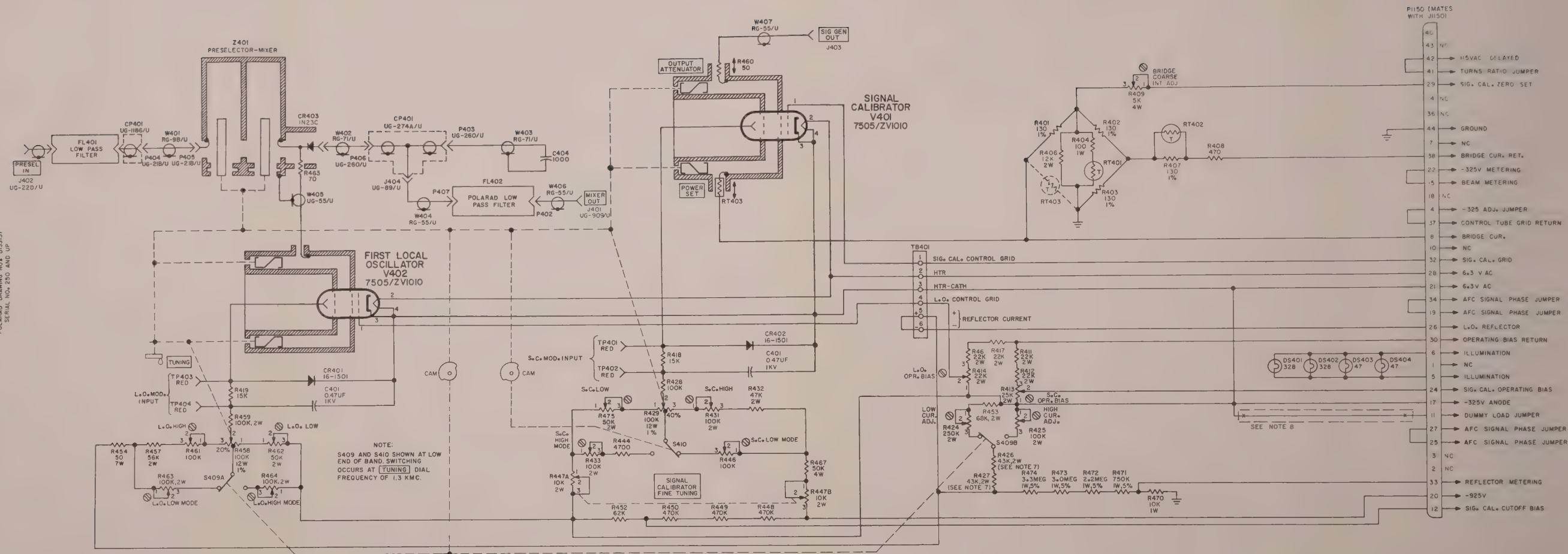
n. All four Tuning Units should now be capable of external pulse modulation. Should any Tuning Unit be unable to be pulsed, repeat the entire alignment procedure with that Tuning Unit installed in the Basic Unit.

SECTION V

DIAGRAMS

5-1. INTRODUCTION.

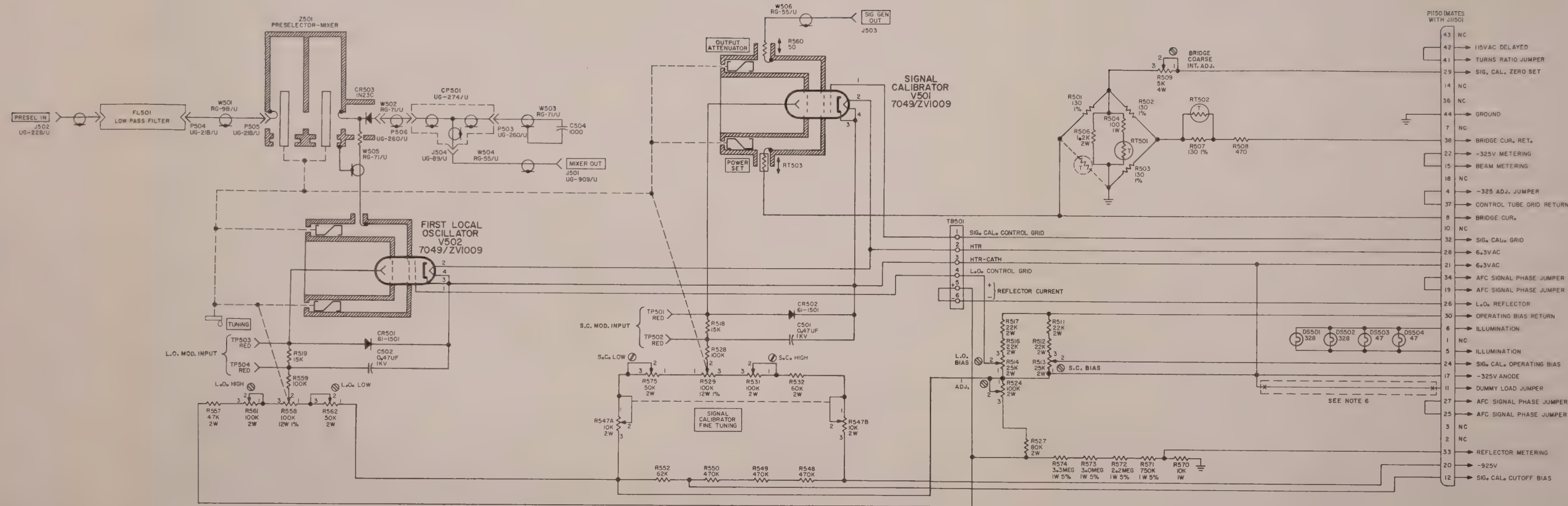
5-2. This section contains schematic diagrams which are of aid in the maintenance and repair of the FIM-2.



NOTES

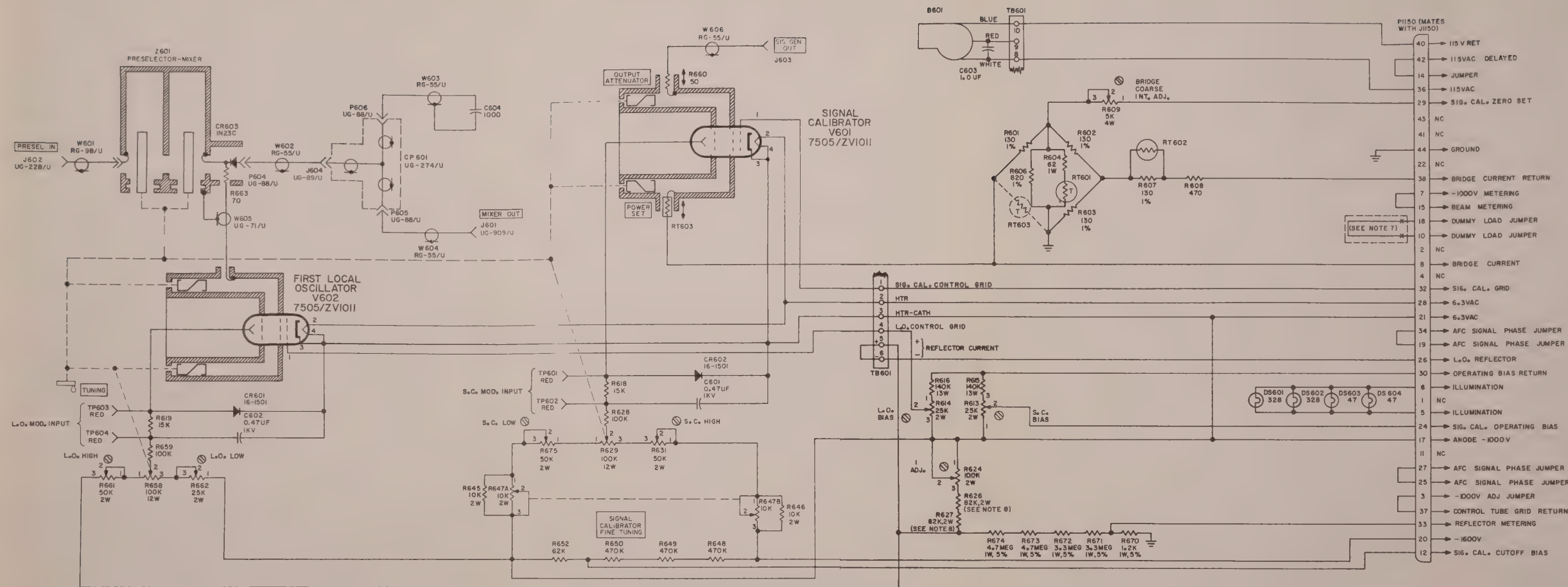
1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (MUF), MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, H FOR HENRY, K FOR KILOHM, OR M FOR MEGOHM.
2. CAPACITORS ARE RATED AT 10% 400 VDCW UNLESS OTHERWISE INDICATED.
3. INDUCTORS ARE RATED AT 120% 1000 VDC TEST UNLESS OTHERWISE INDICATED.
4. RESISTORS ARE RATED AT 10% 1/2 WATT, UNLESS OTHERWISE INDICATED.
5. INDICATES EQUIPMENT PANEL CONTROL.
6. INDICATES SCREWDRIVER ADJUSTMENT.
7. R426 AND R427 ARE 68K, 2WATT FOR SERIAL NOS 250 TO 275, 277 TO 290, 290 TO 299, 301, AND 303.
8. CONNECTION BETWEEN POINTS X-X NOT EMPLOYED IN SERIAL NOS 304 AND UP.

Figure 5-1. Model FIM-L2 Tuning Unit, Schematic Diagram



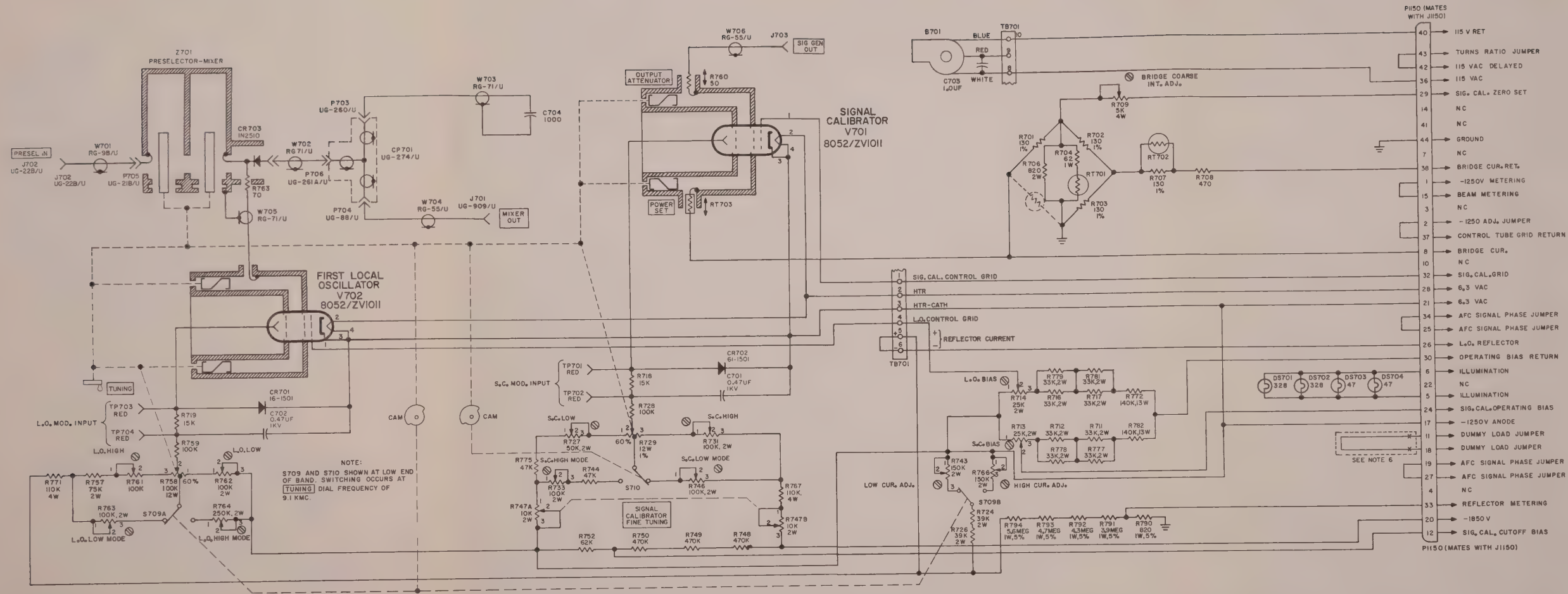
- NOTES:
1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, K FOR KILOHM, OR MEG FOR MEGOHM.
 2. CAPACITORS ARE RATED AT $\pm 10\%$, 400VDC, UNLESS OTHERWISE INDICATED.
 3. RESISTORS ARE RATED AT $\pm 10\%$, 1/2 WATT, UNLESS OTHERWISE INDICATED.
 4. INDICATES EQUIPMENT PANEL MARKING.
 5. INDICATES SCREWDRIVER ADJUSTMENT.
 6. CONNECTION BETWEEN POINTS X—X NOT EMPLOYED IN SERIAL NOS 304 AND UP.

Figure 5-2. Model FIM-S2 Tuning Unit,
Schematic Diagram



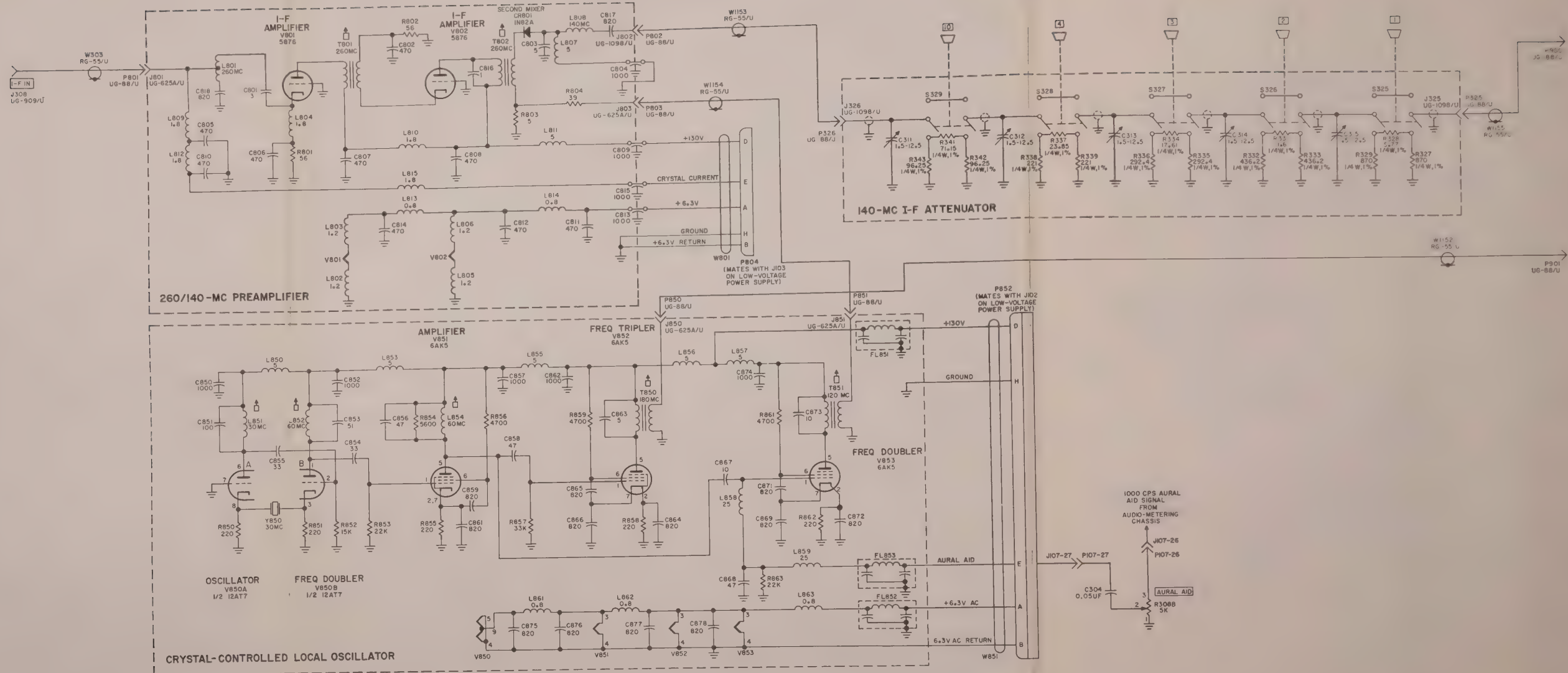
- NOTES:
- ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF), MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, K FOR KILOHM, OR MEG FOR MEGOHM.
 - CAPACITORS ARE RATED AT $\pm 10\%$ 400 VDC UNLESS OTHERWISE INDICATED.
 - INDUCTORS ARE RATED AT $\pm 20\%$ 1000 VDC TEST, UNLESS OTHERWISE INDICATED.
 - RESISTORS ARE RATED AT $\pm 10\%$ 1/2 WATT, UNLESS OTHERWISE INDICATED.
 - INDICATES EQUIPMENT PANEL MARKING.
 - INDICATES SCREWDRIVER ADJUSTMENT.
 - CONNECTION BETWEEN POINTS X-X NOT EMPLOYED IN SERIAL NOS 304 AND UP.
 - R626 AND R627 ARE 75K, 2 WATT FOR SERIAL NOS 250 TO 323.

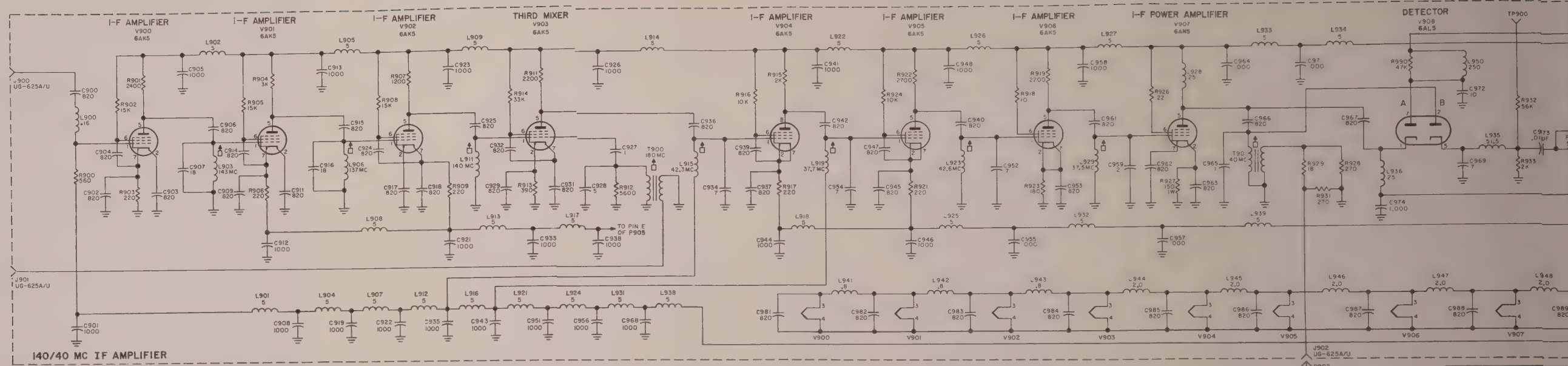
Figure 5-3. Model FIM-M2 Tuning Unit,
Schematic Diagram



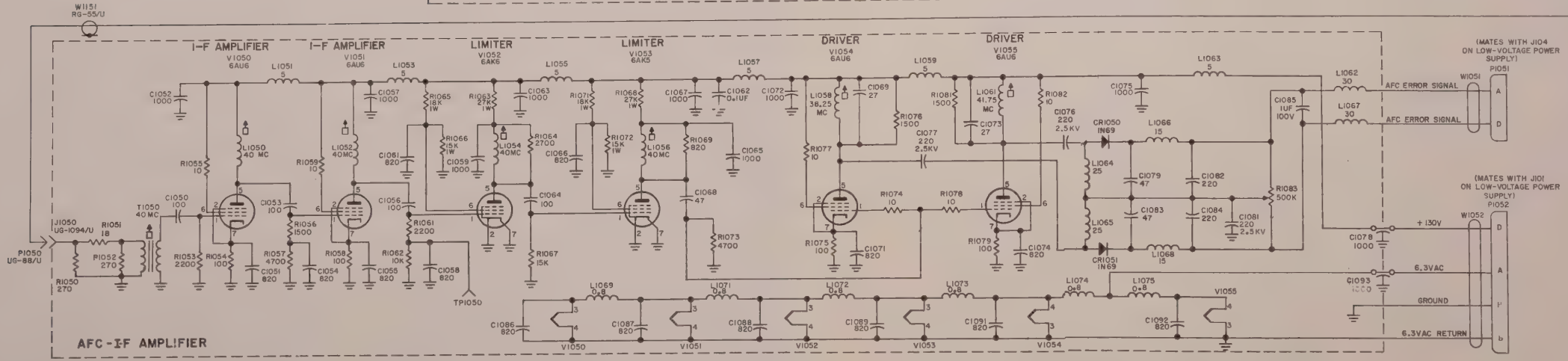
- NOTES
1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF), AND OHMS, UNLESS SUFFICED BY UF FOR MICROFARAD, K FOR KILOHM, OR MEG FOR MEGOHM.
 2. CAPACITORS ARE RATED AT $\pm 10\%$, 400V D.C., UNLESS OTHERWISE INDICATED.
 3. RESISTORS ARE RATED AT $\pm 10\%$, 1/2 WATT, UNLESS OTHERWISE INDICATED.
 4. INDICATES EQUIPMENT PANEL MARKING.
 5. INDICATES SCREWDRIVER ADJUSTMENT.
 6. CONNECTION BETWEEN POINTS X-X NOT EMPLOYED IN SERIAL NOS 304 AND UP.

Figure 5-4. Model FIM-X2 Tuning Unit,
Schematic Diagram

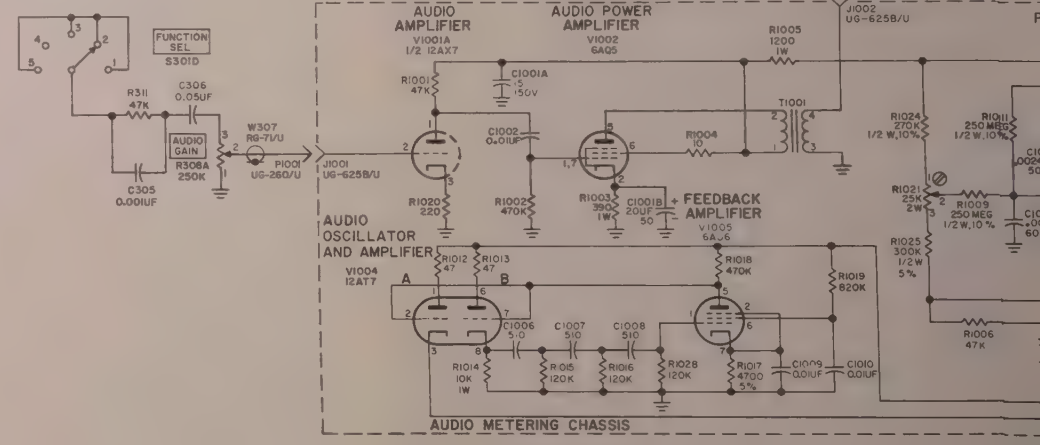




140/40 MC IF AMPLIFIER



AFC-IF AMPLIFIER



AUDIO METERING CHASSIS

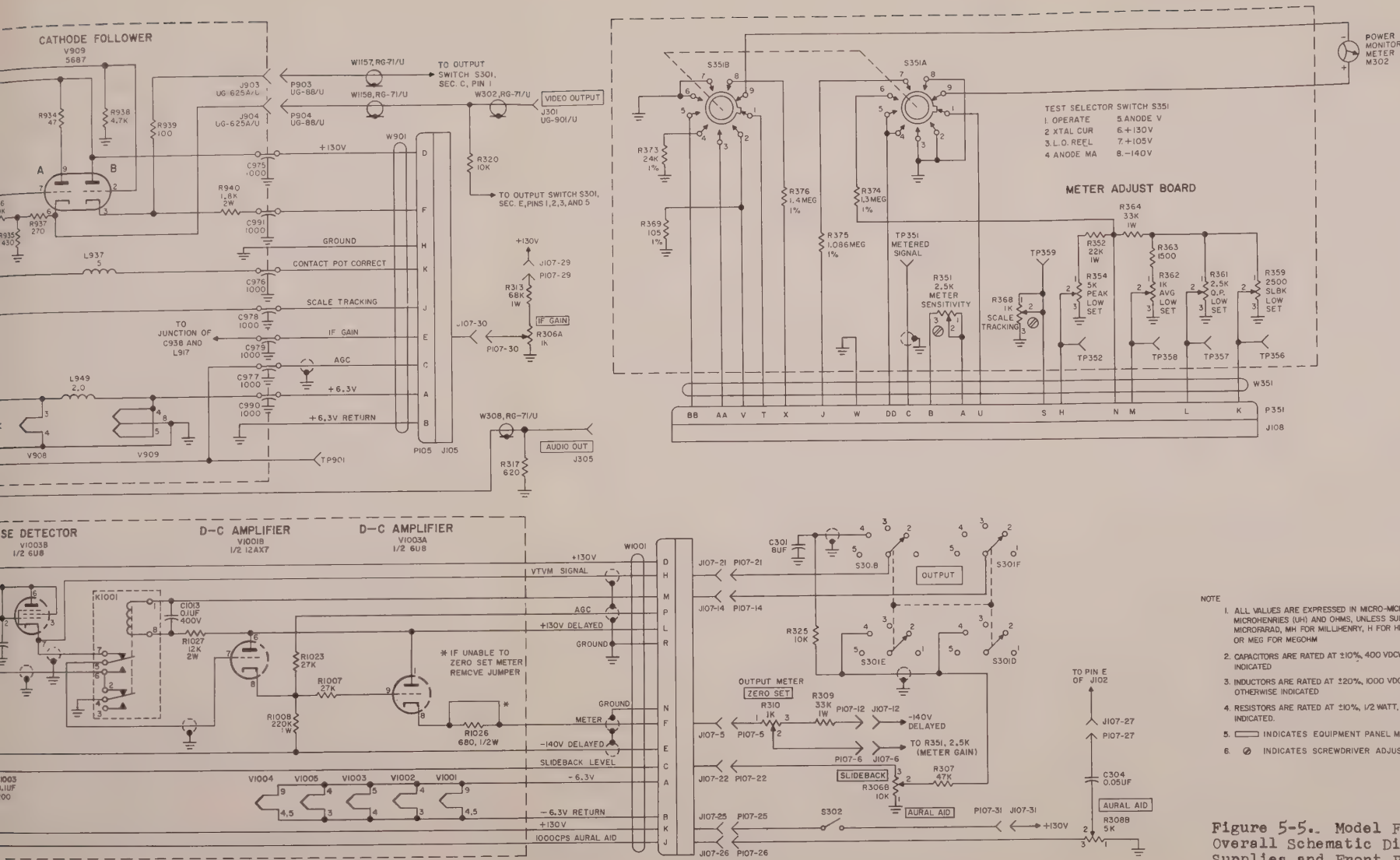
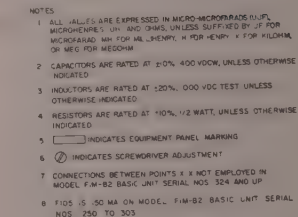
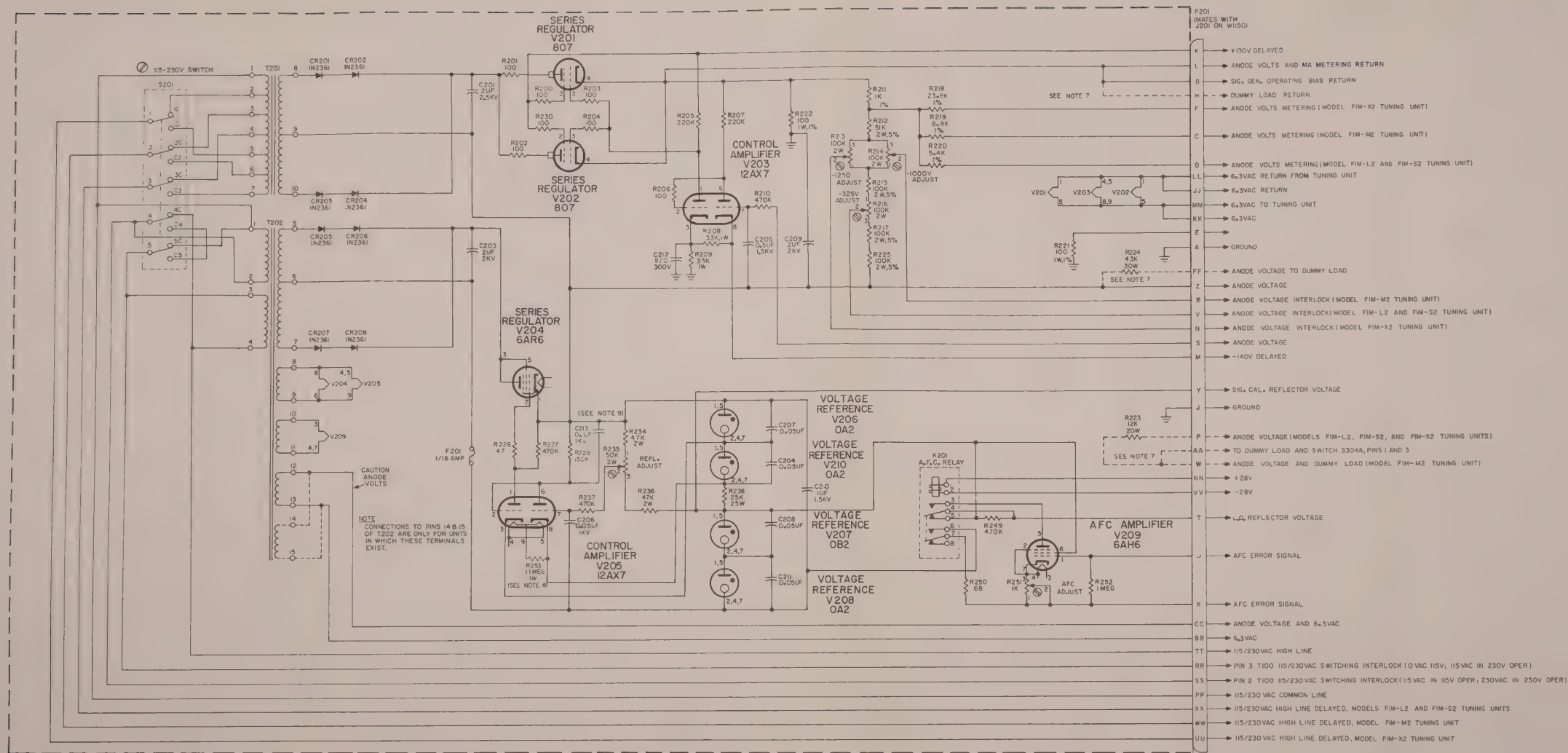


Figure 5-5.. Model FIM-B2 Basic Unit, Overall Schematic Diagram Less Power Supplies and Front Panel Circuitry



5-13/5-14



- NOTES**
- ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (MUF), MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, H FOR HENRY, K FOR KILOHM, OR MEG FOR MEGOHM
 - CAPACITORS ARE RATED AT 10%, 400 VDCW, UNLESS OTHERWISE INDICATED
 - INDUCTORS ARE RATED AT 120%, 1000 VDC TEST, UNLESS OTHERWISE INDICATED
 - RESISTORS ARE RATED AT 10%, 1/2 WATT, UNLESS OTHERWISE INDICATED
 - INDICATES EQUIPMENT PANEL MARKING
 - INDICATES SCREWDRIIVER ADJUSTMENT
 - EMPLOYED IN MODEL FIM-B2 BASIC UNIT SERIAL NOS 250 TO 323 ONLY
 - R253 EMPLOYED IN MODEL FIM-B2 BASIC UNIT SERIAL NOS 304 AND UP
 - C213 EMPLOYED IN MODEL FIM-B2 BASIC UNIT SERIAL NOS 294 AND UP

Figure 5-7. High-Voltage Power Supply, Schematic Diagram

POLARAD ELECTRONICS CORP.

CONSULTANTS — DESIGNERS — MANUFACTURERS

43-20 34th Street Long Island City 1, N. Y.

EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____

DATE: _____

ADDRESS: _____

INDIVIDUAL _____

POSITION _____

SECTION OR DIVISION _____

PHONE NO. _____ EXT. _____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

TROUBLE REPORT:

A. Description of trouble _____

B. Has trouble been localized? _____ If so, how and where: _____

C. Instruments used and measurements taken, if any: _____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

H. Additional Comments: _____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

MICROWAVE SPECTRUM ANALYZERS 10 to 100,000 mc

FEATURING:

- 1 to 30 cps adjustable sweep rate
- Direct-reading UNIDIAL® tuning control, with no klystron modes to set
- High accuracy, resolution and sensitivity
- Frequency dial accuracy $\pm 1\%$
- Non-contacting klystron cavity chokes for noiseless tuning
- Five-inch flat-face CRT
- Provision for use with Multi-pulse Spectrum Decoder (Model SD-1)

TRANSISTORIZED MULTI-BAND,
SINGLE UNIT SPECTRUM ANALYZER

Complete Frequency Coverage, From 10 to 40,880 mc



Model SA-84T

Completely transistorized lightweight unit.

Dispersion: 500 kc to 25 mc, adjustable

Resolution: 20 kc at all frequencies

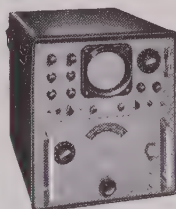
Internal Marker: ± 13 mc

Power Input: 115/230 VAC, 50/60 cps or 12 VDC

Power consumption: when battery operated, 110 watts

Sensitivity: -50 to -105 dbm, depending on frequency.

Weight: 70 lbs. One half the weight of conventional vacuum-tube equivalent



Model TSA

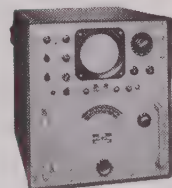
DIRECT READING SPECTRUM ANALYZER

10 to 44,000 mc in
5 Plug-In Tuning Units

To test missiles, radar, microwave components, telemetering and multi-pulse transmission

Features:

- Dispersion: 400 kc to 25 mc
- Resolution: 2 to 80 kc variable
- Attenuation: Continually variable
- Sensitivity: -50 to -95 dbm, depending on frequency
- Internal Marker: ± 14 mc

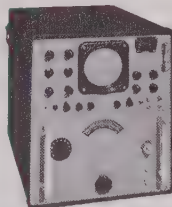


Model TSA-S

COMBINATION SYNCHROSCOPE-SPECTRUM ANALYZER

10 to 44,000 mc in 5 Plug-In Tuning Units

PROVIDES TIME AND FREQUENCY DISPLAYS

Time Display:
Shows signal
waveformFrequency Display:
Shows power
vs. frequencyBandwidth: 5 kc, 50 kc, 500 kc, 5 mc. Synchroscope sweep rate: 2, 10, 100, 1,000, 10,000 and 100,000 μ sec per screen diameter. Dispersion, Sensitivity and Internal Marker same as TSA.

Model TSA-W

WIDE DISPERSION SPECTRUM ANALYZER

FOR NARROW AND WIDE PULSE ANALYSIS

10 to 44,000 mc in 5 Plug-In Tuning Units



Dispersion: 200 kc to 80 mc (2 ranges)

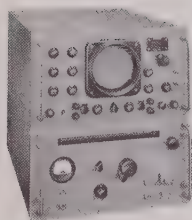
Resolution: 2 to 80 kc variable

Internal Marker: ± 40 mc

Screen Display: Linear or log

80 mc dispersion displays pulses narrow as 0.1 μ sec. For wide pulses, dispersion may be adjusted down to 200 kc.

UNIVERSAL SPECTRUM ANALYZERS

Complete frequency coverage 10-40,880 mc in single self-contained units—no additional tuning units required.
Expanded, direct-reading, slide rule dial

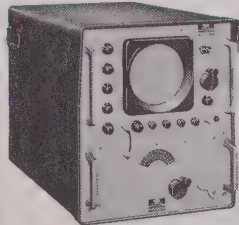
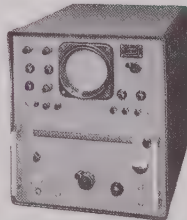
Model SA-84

- Dispersion: 10 to 55 mc: 500 kc to 5 mc, adjustable
55 to 40,880 mc: 500 kc to 25 mc, adjustable
- Resolution: 20 kc
- Internal Marker: variable

Model SA-84W

Wide Dispersion

- Dispersion: 10 mc to 240 mc: 10 mc to 240 mc to 40,800 mc: 80 mc
- Resolution: 2 kc to 80 kc variable
- Crystal controlled markers from 10 to 40,880 mc
- Log-linear display
- Accurately calibrated IF attenuator



Model DA-70

100 KMC SPECTRUM ANALYZER

Covers 50,000 mc to 100,000 mc in Three Bands

- Dispersion: Continuously adjustable from 50 mc to 1000 mc. Permits narrow pulse inspection.
- Resolution: 1 mc
- High intermediate frequency assures image rejection and prevents video detection.
- Frequency marker: for measuring frequency differences.
- Dial frequency Accuracy: $\pm 1.0\%$
- Nominal Sensitivity: -50 dbm for entire frequency range.

WIDE BAND SPECTRUM ANALYZER

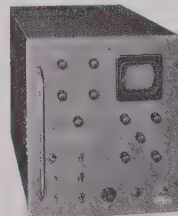
Self-Contained Unit Covers
10 to 40,000 mc in 20 Bands

- Dispersion: 1 mc to 25 mc in narrow band
50 mc to 4000 mc in wide band
- Resolution: 20 kc in narrow band
1.5 mc in wide band
- Rapid band selection by means of illuminated push-button switches.
- Frequency marker up to 4000 mc.
- End-markers indicate frequency limits of each band.
- Center-marker permits switching from wide to narrow bands without hunting for r-f signal.
- Sensitivity: -50 to -80 dbm, depending on frequency.



Model WSA

MULTI-PULSE SPECTRUM SELECTOR



Model SD-1

Permits spectrum analysis of individual microwave pulses in a pulse group when used with any Polarad Spectrum Analyzer. Any pulse in a complex coded signal may be isolated for examination.

POLARAD

ELECTRONICS CORPORATION

33-10 Queens Boulevard, Long Island City 1, New York

FREE LIFETIME

SERVICE



A GUIDE TO MICROWAVE ELECTRONIC TEST INSTRUMENTS

TRANSISTORIZED CALIBRATED FIELD INTENSITY RECEIVER



Model CFI

1,000 to 10,000 mc

Four Interchangeable Plug-In Tuning Units Cover All Frequencies.

Transistorized, low power drain, ruggedized field intensity receiver provides accurate measurements of frequency and absolute power level of conducted or radiated microwave energy. Combines a Field Intensity Calibrator, a Monitor and Power Unit and a Calibrated Antenna System. The Model CFI covers 950 to 11,260 mc when used as a microwave receiver.

Sensitivity:
—90 dbm.

Frequency Dial Accuracy:
±1%

Maximum RF input:
3 volts

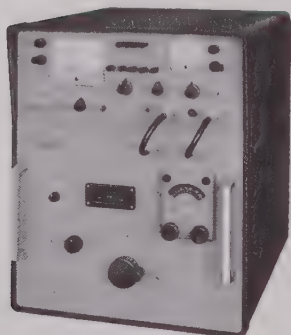
Impulse Bandwidth:
1 mc, 5 mc and 8 mc

Image and Spurious Response Rejection:
Better than 60 db

FEATURES:

- Built-in power inverter for use with 12 volt DC source.
- Direct-reading frequency dial.
- Output level: read directly in db.
- Audio, video and recorder outputs.
- AM, FM, CW and PULSE reception.
- One third lighter than equivalent vacuum-tube Field Intensity Receiver.
- Calibrated antenna system includes an omni-directional band antenna and separate directional antennas to match each tuning unit.

CALIBRATED MICROWAVE FIELD INTENSITY RECEIVER



Model FIM

1,000 to 10,000 mc

Two compatible tuning units under development will extend frequency to 20,000 mc.

Indicates Absolute Power Level By Comparing Input Signal Against Internally Generated Signal In A Single Unit.

Four Interchangeable Plug-In Tuning Units Cover All Frequencies.

- Only Microwave Field Intensity Receiver with self-contained signal generator which calibrates entire system under test at any level.

- First single microwave test system to determine radiated r-f interference and susceptibility.

- Front-panel meter indicates average, peak, slide-back peak or quasi-peak value of r-f signals. Outputs for video, audio and recorder.

- Direct-indicating peak VTVM for ease of frequency location of impulse noise.

- Single UNIDIAL® tuning control tunes both the receiver and signal generator.

- Calibrated antenna system includes an omni-directional broad band antenna and separate directional antennas to match each tuning unit.

Frequency Dial Accuracy:
±1%

Maximum RF Input:
3 volts

Sensitivity:
—80 dbm

Impulse Bandwidth:
5 mc

Image and Spurious Response Rejection:
Better than 60 db

Attenuation:
0 to 80 db in steps of 1 db

MICROWAVE RECEPTION

TRANSISTORIZED MICROWAVE RECEIVER

Fully Transistorized Circuitry Ensures Low Power Drain and Rugged Construction. One-third lighter than equivalent vacuum-tube receiver.

950 mc to 11,260 mc

Four Plug-In r-f Tuning Units Cover All Frequencies.

Four Instruments In One.

- AM, FM, CW, MCW, Pulse receiver
- Field intensity receiver
- Pulse, pulse-time or pulse-position demodulator
- Sensitive power meter

- Power consumption when battery operated, 180 watts. Built in power inverter for use with 12 volt DC battery source.

- AFC and AGC circuits.
- Audio, video and recorder outputs.
- Output level: read directly in db.

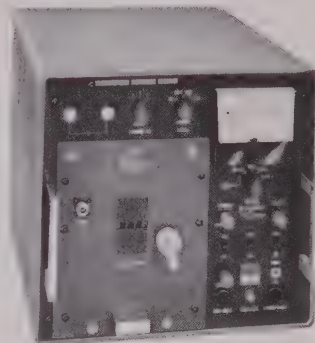
Frequency Dial Accuracy: ±1%

Impulse Bandwidth:
1 mc, 5 mc, or 8 mc

Image Rejection: Better than 60 db

Video Bandwidth: 3.5 mc

Sensitivity: —90 dbm



Model TR

MICROWAVE RECEIVER

400 to 84, 200 mc

Nine Interchangeable Plug-In Tuning Units Cover the Frequency Range.

Four Instruments In One.

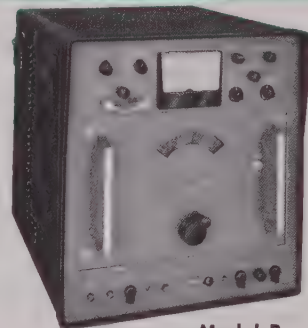
- AM, FM, CW, MCW Pulse receiver
- Field intensity receiver
- Pulse, pulse-time or pulse-position demodulator
- Sensitive power meter

For quantitative analysis of microwave signals, and monitoring of all types of radio and radar communication.

Features: UNIDIAL® control with direct-reading frequency dial. AFC and AGC. Audio, video, recorder and trigger outputs. Output level read directly in db.

Frequency Dial Accuracy: ±1%

I-F Bandwidth: 3 mc



Model R

Video Bandwidth: 2 mc

Image Rejection: Greater than 60 db to 11,260 mc

Range of Linearity: With AGC, 60 db

Sensitivity: —55 to —90 dbm, depending on frequency

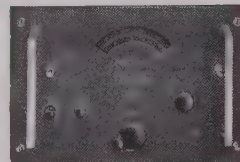
ANTENNA PATTERN TUNING UNIT 2,000 to 75,000 mc

Designed For Use With Model R Receiver

- External Mixer With Flexible Cable. May be located at or near antenna, any distance up to 75 feet from receiver.

- Internal electronic 1000 cps sweep allows direct operation into any standard make AC antenna pattern recorder.

Model RW-T



TRANSISTORIZED MICROWAVE IMPULSE GENERATOR

1,000 cps to
10,000 mc

Model IC-120

For use with microwave receivers when making field intensity measurements, as a signal source for spectrum analyzers, in noise measurements, and other applications. Generates 0.02 nanosecond pulses.



CALIBRATED ANTENNAS

1,000 to 10,000 mc

and
TEST ANTENNAS

1,000 to 40,000 mc



FREE LITERATURE
SERVICE

POLARAD

PROVEN RELIABILITY

A GUIDE TO MICROWAVE ELECTRONIC TEST INSTRUMENTS

MICROWAVE SIGNAL GENERATION EQUIPMENT 500 to 50,000 mc

500 to 21,000 mc. Polarad signal generators in this range feature: Continuously variable attenuators calibrated directly in —dbm. Internal pulse, FM and square wave modulation, external pulse and multi-pulse modulation. Delayed and undelayed sync outputs. UNIDIAL® tuning. Direct-reading frequency dials accurate to $\pm 1\%$. High stability non-contacting klystron cavity chokes for noiseless tuning and accurate calibration.

UHF SIGNAL GENERATOR

500 to 1,000 mc

MICROWAVE SIGNAL GENERATOR

10,000 to
21,000 mc

MICROWAVE SIGNAL SOURCE

1,050 to
11,000 mc

in 4 interchangeable
tuning units.

Model KSS

A stable source of microwave energy at relatively high power output level. Internal square wave 10-10,000 pps. External pulse, square wave or FM modulation. Adjustable attenuator.
Power output: 14 to 400 mw, depending upon frequency.

Model PMK

Two interchangeable generator units.
Internal pulse and square wave modulation (10-10,000 pps.) Output to 10 mw. DIGITAL frequency indicator.
Calibrated power output: +10 dbm (10 mw).

Single unit covers entire frequency range.

Internal pulse (40-4,000 pps), and square wave modulation (10-10,000 pps.) Internal FM with interchangeable modulator.

Calibrated output: 0 dbm (1 mw) to —127 dbm.

Model PMR

ULTRA-BROADBAND MICROWAVE SIGNAL GENERATOR

4,200 to
11,000 mc

in one instrument

Model MSG-34

Internal pulse and square wave modulation (10-10,000 pps.) 0 to —127 dbm attenuator output.
DIGITAL frequency indicator.

MICROWAVE SIGNAL GENERATOR

4,450 to
11,000 mc

Two interchangeable
r-f generator units.

Internal pulse and square wave modulation (10-10,000 pps.) 0 to —127 dbm attenuator output.

Model PMX

MICROWAVE SWEEP GENERATOR FOR INSTANTANEOUS MICROWAVE ANALYSIS 1,000 to 16,000 mc

At single frequency
or over a wide range

in 5 interchangeable tuning units. Provides high-power microwave signal adjustable from single frequency to 2:1 frequency range. .001 to 100 cps sweep rate. Int. mod.: 1,000 cps and 456 kc square wave. Ext. mod.: square wave, FM and pulse.

Model CSG

RAPID SCAN RATIO SCOPE

Model VS-2A

Displays ratio of two input signals, gives visual plot of VSWR as function of frequency, at a single frequency or over an entire sweep range. Calibrated 7" CRT. For use with Model CSG.

MICROWAVE SIGNAL GENERATORS

Frequency	Calibrated Power Output	Internal Pulse Modulation				FM deviation in mc
		Internal Square Wave	Width in μ sec.	Pulse Repetition Rate in pps	Delay in μ sec.	
MSG-1	950-2,400 mc	1 mw (0 dbm)	40- 4,000 pps	0.5-10	40- 4,000	2.5-300 ± 2.5
MSG-1P*	950-2,400 mc	10 mw (+10 dbm)	10-10,000 pps	0.2-10	10-10,000	2-2,000 ± 2.5
MSG-1R	950-2,400 mc	1 mw (0 dbm)	10-10,000 pps	0.3-10	10-10,000	2-2,000 ± 2.5
MSG-2A	2,000-4,600 mc	1 mw (0 dbm)	40- 4,000 pps	0.5-10	40- 4,000	2.5-300 ± 2.5
MSG-2R	2,000-4,600 mc	1 mw (0 dbm)	10-10,000 pps	0.3-10	10-10,000	2-2,000 ± 2.5
MSG-2P*	2,000-4,600 mc	10 mw (+10 dbm)	10-10,000 pps	0.2-10	10-10,000	2-2,000 ± 2.5

*Attenuator Accuracy: ± 3 db between 0 and +10 dbm.
 ± 2 db below 0 dbm.

CODE MODULATED MULTI-PULSE MICROWAVE SIGNAL GENERATOR

950 to 10,750 mc

in 4 interchangeable tuning units. Provides 5 independently adjustable pulse channels, each with variable pulse width and delay. Built-in precision oscilloscope.

Model B

EHF SIGNAL GENERATORS AND SOURCES

12,400 to 50,000 mc. Units in this range provide cw signals, 1,000 cps internal square wave, external modulation provisions, accurate frequency calibration.

EHF SIGNAL GENERATOR 18,000 to 39,700 mc, 7 plug-in units. Accurate power calibration. EHF SIGNAL SOURCE 18,000 to 50,000 mc, 9 plug-in units. High power output.

EHF SIGNAL GENERATOR	Frequency Range	EHF SIGNAL SOURCE
G1822-1	18,000 to 22,000 mc	S1822-1
G2225-1	22,000 to 25,000 mc	S2225-1
G2427-1	24,700 to 27,500 mc	S2427-1
G2730-1	27,270 to 30,000 mc	S2730-1
G3033-1	29,700 to 33,520 mc	S2933-1
G3336-1	33,520 to 36,250 mc	S3336-1
G3540-1	35,100 to 39,700 mc	S3540-1
	39,600 to 46,000 mc	S4046-1
	45,900 to 50,000 mc	S4650-1

Model SG-1218 Signal Generator and Model SS-1218 Signal Source. Available with a frequency range of 12,400 to 17,500 mc.

MAIL THIS CARD

for specifications. Ask your nearest Polarad representative (in the Yellow Pages) for a copy of "Notes on Microwave Measurements."

POLARAD ELECTRONICS CORP.

I WOULD LIKE MORE INFORMATION AND SPECIFICATIONS ON MODEL NUMBERS: (CIRCLE)

SPECTRUM ANALYZERS

TSA	SA-84	DA-70
TSA-S	SA-84T	WSA
TSA-W	SA-84W	SD-1

RECEIVERS

R	RW-T	CFI
TR	FIM	1C-120

ANTENNAS

SIGNAL GENERATORS

PMR	MSG-1	MSG-2P	CSG
PMK	MSG-1P	MSG-2R	VS-2A
MSG-34	MSG-1R	EHF	B
PMX	MSG-2A	KSS	

LABORATORY EQUIPMENT

PJ-1	SV-1	KLYSTRONS
N-1	P-3	MP-1A
		K-200

MY APPLICATIONS ARE:

Name _____ Title _____
Dept. _____ Company _____
Address _____
City _____ Zone _____ State _____

POLARAD
ELECTRONICS CORPORATION

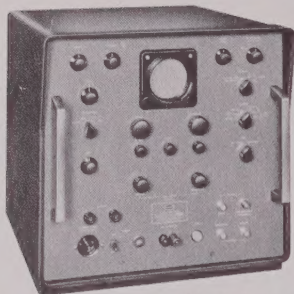
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33-10 Queens Boulevard, Long Island City 1, New York



A GUIDE TO MICROWAVE ELECTRONIC TEST INSTRUMENTS

MICROWAVE LABORATORY EQUIPMENT



Model PJ-1

PULSE JITTER TESTER

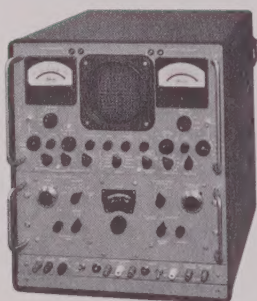
Measures

Relative jitter: 5, 10 and 100 nano-seconds full scale

Pulse width jitter: 5, 10 and 100 millimicroseconds full scale

Repetition rate jitter: 5, 10 and 100 millimicroseconds and 1, 10 and 100 microseconds full scale

Displays: Jitter magnitude and Jitter waveform

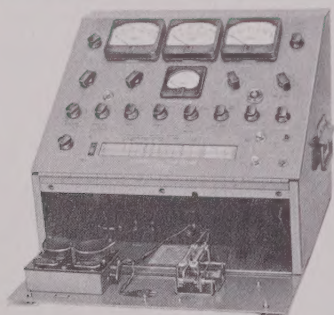


Model SV-1

SERVO-ANALYZER

Combines a precision multiple signal generator and oscilloscope. Feeds a modulated reference test signal through a servo, computer or other system circuit, and compares the response on a calibrated CRT scope. Tests amplitude, phase and transient response, response of magnetic and servo amplifiers, all AC and DC servo systems. Signal generator and oscilloscope may operate independently.

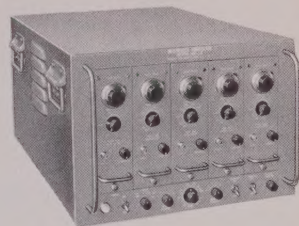
Frequency Range: .001 to 100 cps in 5 ranges.



Model K-200

MICROWAVE TUBE TESTER

Tests both internal cavity and external cavity klystron tubes, pencil triodes, rocket tubes and lighthouse tubes. Operates as simply as conventional tube testers. Monitors cathode, anode, grid and reflector voltages and currents. Tests for shorts and filament continuity.



Model MP-1A

CODED MULTI-PULSE GENERATOR

Provides up to five independently adjustable pulse channels for generation of precise coded multi-pulse trains. Each pulse can be independently pulse-time modulated by means of an external signal.

Modulation:

Group repetition rate, 10-10,000 cps
Individual pulses, in group:
Width: 0.2 to 2 μ sec.
Delay: 0 to 300 μ sec. in two steps
Provision for pulse-time modulation



Model N-1

PRECISION NOISE GENERATOR

1,000 cps to 500 mc — 1 to 20 db

Provides stable, accurate noise output to measure directly the noise figure of vacuum-tube and transistor amplifiers and receivers in the 1,000 cps to 500 mc range.

Dial Calibration: Noise figure indicated directly in db
Accuracy: ± 0.25 db



Model P-3

TRANSISTORIZED MICROWAVE POWER METER

10 to 40,000 mc

Measures absolute r-f power instantly. Line or internal battery operated. Rugged, weighs only 6 pounds. Five interchangeable thermistor mounts cover the frequency range. Direct readings in milliwatts or dbm. High sensitivity allows 0.01 milliwatt full-scale deflection; other ranges, up to 10 milliwatts full scale.

ALL-CERAMIC REFLEX KLYSTRON TUBES

Polarad Tube Type	Frequency Range
ZV 1012	500 to 3,000 mc
ZV 1010	700 to 3,000 mc
ZV 1010X	950 to 2,800 mc
ZV 1021X	1,000 to 4,000 mc
ZV 1009	1,500 to 6,000 mc
ZV 1009X	1,700 to 5,000 mc
ZV 1011	4,000 to 11,000 mc



X Series Klystrons have 200 mw minimum output.

Maximum shock, vibration and heat resistance. Guaranteed for operation up to 250°C; no cooling required. Low noise, stable and low microphonic operation.

Postage
Will be Paid
by
Addressee

No
Postage Stamp
Necessary
If Mailed in the
United States

BUSINESS REPLY CARD

First Class Permit No. 18, Long Island City 1, N. Y.

POLARAD ELECTRONICS CORP.
33-10 QUEENS BOULEVARD,
LONG ISLAND CITY 1, N. Y.

MAIL THIS CARD
for specifications.
Ask your nearest
Polarad representa-
tive (in the
Yellow Pages) for
a copy of "Notes
on Microwave
Measurements."

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POLARAD
ELECTRONICS CORPORATION
33-10 Queens Boulevard, Long Island City 1, N. Y.

THESE ARE POLARAD REPRESENTATIVES IN THE UNITED STATES AND THROUGHOUT THE WORLD

DOMESTIC REPRESENTATIVES

ARIZONA CALIFORNIA NEVADA

T. Louis Snitzer Company
5354 W. Pico Blvd.
Los Angeles, Calif.
Webster 8-2074

T. Louis Snitzer Company
7814 Ivanhoe Ave.
La Jolla, Calif.
Glencourt 4-2191

T. Louis Snitzer Company
510 S. Mathilda Avenue
Sunnyvale, Calif.
Regent 6-6733

ARKANSAS LOUISIANA OKLAHOMA TEXAS NEW MEXICO

Industrial Associated Electronics
2311 Farrington
P.O. Box 10876
Dallas, Texas
Riverside 8-0780

Industrial Associated Electronics
Room 2018
International Airport Terminal
El Paso, Texas
Prospect 2-2441

ILLINOIS INDIANA WISCONSIN

Loren F. Green & Associates
5218 West Diversey Avenue
Chicago, Illinois
Palisades 5-6824

OHIO WESTERN PA. MICHIGAN

Harvey Teplitz & Co.
3718 Salem Avenue
Dayton 6, Ohio
Crestview 7-9178

Harvey Teplitz & Co.
671 Sycamore Drive
Cleveland, Ohio
Redwood 1-5676

Harvey Teplitz & Co.
19942 Inkster Road
Detroit 19, Michigan
Kenwood 7-9058

ALABAMA FLORIDA GEORGIA MISSISSIPPI N. CAROLINA S. CAROLINA TENNESSEE

Murphy and Cota
2110 Peachtree Road, N.W.
Atlanta 5, Ga.
Trinity 6-3020

Murphy and Cota
1106 Burke Street
Winston-Salem, N.C.
Park 4-0750

Murphy and Cota
2319 E. South Street
Orlando, Fla.
Garden 4-2167

Murphy and Cota
250 Governors Drive
Huntsville, Ala.
Jefferson 6-9121

NEW ENGLAND

George Gregory Associates
7 Erie Drive
Natick, Mass.
Olympic 5-1330

George Gregory Associates
9 South Street
Cheshire, Conn.
Broning 2-5040

MISSOURI KANSAS IOWA NEBRASKA

Engineering Services Co.
4550 Main Street
Kansas City 11, Mo.
Pi-3-7227 1-7765

Engineering Services Co.
6717 Vernon Avenue
St. Louis, Mo.
Parkway 6-2233

Engineering Services Co.
247 South Pinecrest
Wichita, Kansas
Murray 3-3751

Engineering Services Co.
106 29th Street N.E.
Cedar Rapids, Iowa
Empire 5-6183

METROPOLITAN NEW YORK CITY

Home Office
Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, N.Y.
Exeter 2-4500

Joe P. Schindler
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Waverly 7-6269

Eastern Instrumentation, Inc.
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261 Genesee Street
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Skyline 6-1589

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700 S.E. Hawthorne Blvd.
Portland, Oregon
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Mel Sales Ltd.
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P.O. Box 2165
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GREECE

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44 Eleftheriou Venizelou
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ITALY

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MEXICO

Standard Electrica de Mexico, S.A.
Calle Madrid 21-F
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NEW ZEALAND

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7 Anzac Avenue
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PERU

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PHILIPPINES

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P.O. Box 1400
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PORTUGAL

Equipamentos de
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SOUTH AFRICA

Leigh & Hurwitz (Pty) Ltd.
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